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REMEDIAL ACTION WORK PLAN

OPERABLE UNIT 3, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE WARREN COUNTY, NEW JERSEY

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ACRONYMS AND ABBREVIATIONS

3D	three-dimensional
cm^2	square centimeters
cm/sec	centimeters per second
lb/hr	pounds per hour
mg/kg	milligrams per kilogram
ppm	parts per million
scfm	standard cubic feet per minute
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
AC1	Area of Concern 1
AIDV	Analytical Interval Data Value
Albéa	Albéa Americas, Inc.
ANC	American National Can
bgs	below ground surface
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
CO	carbon monoxide
CO_2	carbon dioxide
CQA	construction quality assurance
CQAPP	Construction Quality Assurance Project Plan
CVOCs	chlorinated volatile organic compounds
DNAPL	dense non-aqueous phase liquid
DL	drain lines
DO	dissolved oxygen
DOT	Department of Transportation
DRM	diesel particulate
ECD	electron capture detector
EDD	Electronic Data Deliverables
ENVIRON	ENVIRON International Corporation
ERH	electrical resistance heating
EV	electron volt
EVS	Earth Volumetric Studio
GAC	granular activated carbon
GC	gas chromatograph
GWETS	Groundwater Extraction and Treatment System
HC	hydrocarbons
HCHO	diesel odor
ICs	institutional controls
ICIAP	Institutional Control Implementation and Assurance Plan
IDW	investigative-derived waste
ISTR	*in-situ* thermal remediation

MNA	monitored natural attenuation
MS/MSD	matrix spike/matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
NJDEP	New Jersey Department of Environmental Protection
NPT	National Pipe Tapered
NTUs	nephelometric turbidity units
OM&M	operation, monitoring, and maintenance
ORP	oxygen reduction potential
OU1	Operable Unit 1
OU2	Operable Unit 2
OU3	Operable Unit 3
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
PDI	pre-design investigation
PID	photoionization detector
PPE	personal protective equipment
PPPI	Pechiney Plastic Packaging, Inc.
PPW	private potable well
PTFP	polytetrafluoroethylene
P/TSE	Pilot/Treatability Study Evaluation
PVGCS	Pohatcong Valley Groundwater Contamination Superfund
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
RA	remedial action
Ramboll	Ramboll US Corporation
RAOs	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RD	remedial design
RD/RA	Remedial Design/Remedial Action
RDWP	Remedial Design Work Plan
RG	remedial goal
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SEE	steam-enhanced extraction
SOF	soluble organics
SOPs	Standard Operations Procedures
SOTA	state-of-the-art
SOW	Statement of Work
SSD	sub-slab depressurization
SSO	Site Safety Officer
SVE	soil vapor extraction

SVOCs	semivolatile organic compounds
T&D	transportation and disposal
TBC	to-be-considered
TCH	Thermal Conductive Heating
TOC	total organic carbon
trichloroethene	TCE
TPY	tons per year
TTZ	target treatment zone
UL	Underwriters Laboratories Inc.
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
VTC	Vikon Tile Corporation
VIRA	Vapor Intrusion Removal Action
VMP	vapor monitoring probe
VOCs	volatile organic compounds
WLY	Warren Lumber Yard

1. INTRODUCTION

1.1 Purpose and Scope of Remedial Action

On behalf of Pechiney Plastic Packaging, Inc. (PPPI), Ramboll US Corporation (Ramboll) has prepared this Remedial Action Work Plan (RAWP) for the remedy selected by the United States Environmental Protection Agency (USEPA) to address trichloroethene (TCE) impacts in vadose zone soils at Operable Unit 3 (OU3) of the Pohatcong Valley Groundwater Contamination Site (PVGCS), hereinafter referred to as "Site" located in Warren County, New Jersey (United States Environmental Protection Agency [USEPA] ID# NJD981179047).

The PVGCS site encompasses an area of about 16.5 square miles (10,600 acres) that extends about 8.5 miles along the length of the Pohatcong Valley, which is a northeast-southwest trending valley bounded by mountains. The location of the Site is shown in Figure 1. The Site is divided into three operable units. The OU3 Study Area is located in Washington Borough and is defined by the USEPA as the area that has been identified as the source area for TCE within the aquifer. The OU3 Study Area comprises four properties known as: ANC Area of Concern 1 (AC1), Vikon Tile Corporation (VTC), and Warren Lumber Yard (WLY) properties. A site map showing the location of OU3 is presented on Figure 2. This RAWP focuses on remediation of Source Area A, which contains the deep TCE-contaminated soils underlying the southwestern portion of the former ANC building identified as the volume of soils to be treated in the USEPA's Record of Decision (ROD)[1] for OU3.

As provided in the ROD, the major components of the selected remedy for OU3 (Source Area A) include:

- The implementation of deep soil vapor extraction (SVE) and/or thermal treatment to address deep soil contamination underlying the former American National Can (ANC) building.
- Long-term operation and maintenance of the existing shallow SVE and sub-slab depressurization (SSD) systems within the former ANC building.
- Long-term groundwater and indoor air monitoring in the OU3 Study Area will be performed over time to assess the remedy's effectiveness.
- Institutional controls (ICs), including the existing deed notice, will remain in effect at the former ANC property and will be amended to reflect the components of the selected remedy for OU3 that will be implemented at the former ANC property. The institutional controls periodically will be verified as remaining in effect as part of the long-term monitoring effort.

Based on soil sampling results obtained at OU3 (Source Area A) during pre-design investigations, SVE pilot testing, and technical evaluations of various thermal remediation technologies as presented in the Final (100%) Remedial Design Report (Ramboll, 2019), In-Situ Thermal Remediation (ISTR) using thermal conductive heating (TCH) technology is proposed as the preferred manner for addressing soils at OU3 (Source Area A). Pursuant to Section IX of the USEPA approved Statement of Work (SOW)[2] for OU3, the Consent Decree (CD)[3], and the design for the selected remedy identified in the USEPA ROD for treatment of soils of Source Area A of

[1] USEPA Record of Decision – OU3 Study Area dated September 30, 2016.

[2] USEPA approval of the OU3 Statement of Work in a letter dated June 26, 2017.

[3] In the matter of United States of America v. PPPI (Civil Action No. 09-cv-05692) and United States of America v. Bristol Myers Squibb Company, et al. (Civil Action No. 13-cv-05798) effective March 11, 2015.

OU3, Ramboll, on behalf of PPPI submitted the Final (100%) Remedial Design Report to USEPA on April 24, 2019. In a letter dated May 23, 2019, USEPA approved the Final (100%) Remedial Design Report.

In a letter dated June 25, 2019, PPPI provided notice to USEPA of award of contract for remedial action to Ramboll US Corporation with Cascade Environmental, LLC as the selected thermal remediation contractor. On September 19, 2019, PPPI orally communicated to USEPA of a change in the thermal remediation contractor to TRS Group, Inc. (TRS) to implement the OU3 Remedial Action. A written notice of change in the subcontractor to TRS for implementation of ISTR for the OU3 Remedial Action at the PVGCS Site along with a statement of their relevant qualifications to perform this work was provided to USEPA in correspondence dated October 7, 2019.

With TRS as the selected remediation subcontractor for ISTR, no change in the design basis, intent of design, scope or performance of the ISTR Remedial Action was necessary. Minor changes in patented TCH wells to be installed and a change in sequence of implementation due to limited drill rig and crew availability over the course of the project and to maintain the schedule for RA completion were presented to USEPA via teleconference on October 8, 2019. Details of these changes were subsequently provided in two separate Remedial Action Addendum submittals (Remedial Action Addendum No. 1 and Remedial Action Addendum No. 2) to USEPA on October 24, 2019 and November 14, 2019, respectively. Remedial Action Addendum No.1 presented details on the proposed minor changes to the subsurface TCH well design, wellfield layout, a revised thermal model, a revised Construction Quality Assurance Plan (CQAP), sequence of TCH well installation, including operation of the ISTR system in three separate groups of heaters (i.e., starting with Group A heaters, while Group B heaters are being constructed; then operation of Group B heaters while Group C heater construction is completed; and lastly operation of Group C heaters), and a revised draft RD/RA time schedule for OU3 reflecting the changes in drilling schedule and phased heating of the different groups of heaters for this Remedial Action. Remedial Action Addendum No.2 presented details on the proposed minor changes to the above-ground ISTR system components, including a revised Operation, Maintenance and Monitoring Plan (OM&M Plan), an updated remedial design drawing package, a revised Traffic Management Plan, Field Sampling Plan, and Health and Safety Plan.

This work plan incorporates all USEPA comments received on the Remedial Action Addenda discussed above and presents the implementation activities associated with the construction, installation, startup, and decommissioning of the approved thermal treatment remedy. In addition, the required permitting activities for construction and operation of the ISTR system along with remedial action reporting activities, including the RA implementation schedule is presented.

1.2 Work Plan Organization

As described in the sections that follow, this Work Plan provides the proposed plan and methodology for construction, installation and startup of an In-situ Thermal Remediation (ISTR) system to address the identified deep soil contamination underlying the former ANC building:

- Section 2 – Project Organization
- Section 3 – Summary of Approved Remedial Action
- Section 4 – Remedial Construction Activities
- Section 5 – Construction Quality Control
- Section 6 – System Functional Testing and Startup
- Section 7 – System Operation, Maintenance and Monitoring

- Section 8 – Health, Safety, and Environmental Protection Measures
- Section 9 – Permits
- Section 10 – ISTR System Decommissioning
- Section 11 – Remedial Action Reporting
- Section 12 – Schedule
- Section 13 – References

These tasks are discussed in detail in the sections that follow. The appendices provide construction contractor certifications (as requested by USEPA in their review of the Pre-final (90%) Remedial Design Report), a Construction Quality Assurance Plan, a Traffic Management Plan, a Field Sampling Plan, a Waste Management Plan, the ISTR system Operations, Maintenance, and Monitoring Plan (OM&M Plan), a Health and Safety Plan, and a Contingency Plan for the tasks to be performed during the remedial action.

2. PROJECT ORGANIZATION

This section presents the construction management organization for the OU3 remedial action (RA).

2.1 Construction Management Organization

This section presents the construction management organization for the OU3 RA, including project management roles, lines of communication, and responsibilities. Lead agency oversight for these RA activities will be provided by USEPA Region 2. The USEPA Remedial Project Manager for OU3 is Michelle Granger. The United States Army Corps of Engineers (USACE) will provide oversight and technical support to USEPA for the RA activities. PPPI is responsible for implementing the OU3 RA and has retained Ramboll as its Supervising Contractor and TRS Group as its Remediation Contractor for the OU3 RA. Albéa is the Owner Settling Defendant to the CD. A project organization chart is provided as Figure 3.

2.1.1 PPPI Roles and Responsibilities

PPPI is responsible for implementation of the OU3 RA as required by the CD and the OU3 Statement of Work (SOW). On behalf of PPPI, Luis Hidalgo of Rio Tinto is the designated Project Coordinator for OU3. Brad Gibson and John Herring of Rio Tinto will serve as Site Managers during the implementation and will be responsible for managing compliance with Rio Tinto's health, safety, environment and quality management system (HSEQ MS) including monitoring safety needs and providing support to field construction staff.

2.1.2 Albéa Roles and Responsibilities

Ramboll has worked closely with the Owner Settling Defendant to the CD, Albéa, to integrate their operational and health and safety constraints into the implementation of the RA and continued vapor intrusion removal action on the former ANC property. The on-site Plant Manager is Mr. Daniel Fortaney. Mr. Felix Miranda is the on-site Environmental Health and Safety (EHS) Manager, and Mr. Russell Gladd is the on-site Plant Maintenance Manager.

Albéa remains committed to complying with its obligations under the CD to provide access to the site for PPPI to implement the RA for OU3. PPPI has coordinated with Albéa to move their current operations in the former Molding Room Area to an off-site warehousing location such that the former Molding Room Area will be available for the necessary duration for implementation of the

RA for OU3. This will enable the installation of all the planned heater borings from within the former Molding Room Area to reach the target treatment zone for the OU3 RA.

2.1.3 Ramboll Roles and Responsibilities

PPPI has retained Ramboll as its Supervising Contractor for the OU3 RA, pursuant to the CD Section VI, paragraph 12.a. Mr. Bruce Kennington is the Ramboll Project Director and is the identified Alternate Project Coordinator under the CD for OU3. As Ramboll Project Director, Mr. Kennington reports to Dave Schlott (Principal Manager for Ramboll), thereby providing overall guidance and accountability, contract administration support, and ensuring adequate allocation of resources. In his capacity as Ramboll Project Director and Alternate Project Coordinator for OU3, Mr. Kennington reports to Luis Hidalgo on all matters for OU3 at the Site. In addition, David Heidlauf, a Principal Manager with Ramboll, will provide overall technical support. For management of health and safety for the project, Jeff Parsons will be responsible for managing compliance with the project-specific health and safety program and Nita Shinn and Adrian Ezeagu will serve as the lead Ramboll Site Safety Officers (SSOs).

Technical support on the ISTR implementation will be provided by Scott Tarmann (Project Engineer, Ramboll). Mr. Tarmann currently serves as the Project Engineer for the OU1 (TCE) Groundwater Extraction and Treatment System (GWETS) and Vapor Intrusion Removal Action (VIRA). Construction Quality Assurance Officer, Cynthia Bonczkiewicz, will be responsible for ensuring that the quality control testing required by the project specifications are conducted. Field work for the drilling activities will be managed by Stan Popelar and Michael Eddings (Field Manager and Senior Geologist). Field work for the installation/construction activities will be managed by James Cavotta. Field work for sampling activities will be managed by Stan Popelar and Angela DeDolph.

Technical support on the electrical supply installation and coordination for the high voltage line from the transmission line to the ISTR system electrical power control units will be provided by Ramboll. Subcontractors will assist Ramboll in the installation of the power supply, testing, and inspections, as appropriate.

2.1.4 TRS Group Roles and Responsibilities

The selected ISTR system contractor is TRS Group, Inc. ("TRS") for the construction, operation and decommissioning for the OU3 ISTR remedy. For implementation of the ISTR system, TRS will designate their own site Health and Safety officer, construction quality assurance (CQA) officer, and construction supervisor. TRS will be responsible for their subcontractors, field crew and field equipment.

TRS has assembled an experienced team to support the implementation of ISTR activities at the Site. Overall, the project will be technically led and managed by Chris Thomas, Project Manager; Dan Oberle, Project Engineer; and Gorm Heron, ISTR Technical Lead. The drilling work and construction program will be led by Kevin Riffe, Construction Manager.

TRS has subcontracted the drilling work to multiple drilling firms to support the drilling operations for the OU3 ISTR remedy. The drilling operations will be led by Summit Drilling, Inc. a licensed drilling contractor in the state of New Jersey, with support from Great Southern Engineering (GSE), Parratt Wolff, Inc, and Summit Drilling.

TRS will be assisted by a New Jersey licensed electrical subcontractor and their certifications will be included as Appendix A in the final RAWP.

3. SUMMARY OF APPROVED REMEDIAL ACTION

Based on the results of a Pre-Design Investigation, Environmental Visualization System (EVS) modeling of TCE impacts greater than 1 milligram per kilogram (mg/kg), and SVE pilot testing, the remedy selected and approved by the USEPA includes the implementation of ISTR using TCH technology to address deep soil contamination underlying the former ANC building. To attain the site-specific RG of 1 mg/kg within the TCE-impacted soils, a TCH system with co-located vapor extraction wells (VEWs) was designed for a targeted treatment zone (TTZ) of approximately 28,000 cubic yards. Additionally, the shallow SVE and the SSD systems installed as part of the VIRA will continue to operate during the implementation of the deep soil remedy. The remedy includes long-term groundwater and indoor air monitoring; and institutional controls. Components of the TCH remedial action (RA) include angled and vertical heater wells, co-located VEWs, temperature monitoring points (TMPs), vapor monitoring probes (VMPs), and a vapor and liquid treatment system.

Vapors and liquid discharge streams from the ISTR system will be treated using carbon-based vapor and liquid treatment systems. The liquids will be containerized and conveyed to the existing GWETS for disposal to the on-site GWETS injection wells. Treated vapors will be discharged to atmosphere through an emissions stack under a New Jersey Department of Environmental Protection (NJDEP) air permit to operate.

4. REMEDIAL CONSTRUCTION ACTIVITIES

This section provides a discussion of the RA activities associated with the construction of the ISTR system. Construction of the ISTR system generally includes but is not limited to: pre-construction site preparation; heater well and monitoring point installation; electrical service installation; process equipment installation; and system decommissioning. The RA activities also include system functional testing, inspections, and system startup and operation. The ISTR system has been designed to reduce TCE contaminant mass in the vadose zone soil. TCH within the TCE impacted soil volume will be performed sequentially in three separate groups and is discussed in further detail below. Construction of the ISTR system will include work in the Former Molding Room of the former ANC building, some limited work in the Main Production Area of the building, and exterior work along the west and southwest sides of the Albéa building. Temporary equipment and materials staging laydown areas will be utilized on the north, west, and south sides of the facility during construction of the ISTR. The layout of the OU3 work areas and temporary laydown areas are shown on Figure 4.

In order to complete the construction and startup of the ISTR system, some activities will occur simultaneously with multiple construction crews. Construction activities presented in this section are in general chronological order. The following sections describe the planned construction activities for the ISTR system.

4.1 General Sequence of Construction

Following approval of this RAWP, personnel, equipment, and materials necessary to complete the installation of the ISTR system for OU3 will be mobilized to the Site. This includes a project/office and storage trailers with a temporary power supply to the office trailer and establishment of a high-speed internet connection. In addition, a wall is planned to be installed along the northwest portion of the molding room to provide a temporary barrier to isolate Albéa workers and facility operations from the ISTR construction activities and to help reduce noise levels outside the

molding room from drilling activities. The wall is being installed on a temporary basis and may be removed at the completion RA activities. This temporary wall will be constructed using 3-5/8" 20-gauge metal studs at 16" on center with 5/8" type "X" gypsum wall board on each side and 3 ½" therma-fiber insulation. The wall will be 16'-4" high and 89'-3" in length and will be equipped with a door that is 6'-0" wide x 7'-0" high that is fire-rated and equipped with the necessary automatic door closing hardware.

To facilitate drilling of the angled heater fans inside the molding room, the existing ventilation ducts on the ceiling will be disassembled to allow space for the sonic drilling rigs to operate properly and be set-up and positioned at each heater fan location. Following the vent duct removal, the duct penetrations at the walls of the molding room will be temporarily capped and sealed. The duct sections removed from the molding room will be stored in a designated laydown area outside the Albéa building and placed on wood dunnage and covered with tarps. The ventilation duct will be reinstalled at the completion of the remedy and following abandonment of the TCH wells and decommissioning of the interior ISTR system.

With the former molding room fully enclosed, modifications to the existing air handling system will be performed to control the room temperature and provide sufficient ventilation while work activities are being performed. Modifications to the existing ventilation system will include utilizing the two existing air handling units inside the molding room to supply air into the room, and three roof-top centrifugal exhaust fans will be installed to exhaust the air from the room. Each air handling unit will be adjusted accordingly so the volume of air exhaust is greater than the volume of air supplied (a net removal of air from the molding room/building). At the completion of the remedy and following abandonment of the TCH wells and decommissioning of the interior ISTR system, the rooftop ventilation system will be removed, and the existing air handing units will be returned to their pre-construction operational settings. During drilling, exhaust from the equipment will be directly vented from the former molding room to the outdoors by installing and maintaining flexible exhaust hose/booster fans from each drill rig as needed.

Pre-construction activities include obtaining the appropriate construction and building permits, well construction permits, air permit (modification to PPPI's existing permit to operate) and providing notification to the NJDEP for the ISTR system liquid treatment and condensate discharge to the GWETS through the existing Discharge to Groundwater permit equivalency. Additionally, the utilities will be located at the Site and temporary fencing and/or barricades will be installed around the perimeter of the construction and support areas to control facility employees from entering the interior work zone during construction activities.

Initial site construction activities include surveying the wellfield to stake out/mark the planned TCH wells, TMP locations, and VMP locations in accordance with the design plans. The TCH wells, TMPs, and VMPs will then be installed using roto-sonic drilling methods to the design treatment and monitoring depths.

TRS has devised an approach to heat the soil in the TTZ in a sequential manner to improve the remediation completion timeframe. The sequential heating approach utilizes three heating groups, A, B, and C in which heating operations commence at different times during implementation of the RA. Group A is designated as the northern portion of the TTZ beneath the MPA and includes angled heater fans 7 through 15; Group B is designated as the southern portion of the TTZ beneath the MPA and includes angled heater fans 1 through 6; and Group C is designated as the remaining portion of the TTZ beneath the molding room and includes all vertical and angled TCH wells as shown on design drawing C102 (Wellfield Layout) in Remedial Action Addendum No. 1. Drilling of the TCH wells will start on the north end in Group A. Once drilling is complete in Group

A, the drill crews will begin the install of TCH fans 1 through 6 and the angled TCH well located in Group B. Surface construction (installation of the heater elements, completion of TCH wellhead electrical connections, installation of process vapor piping, and process treatment equipment) will begin in Group A while Group B drilling occurs. Group A system functional testing, pre-final/final inspection, and startup of the ISTR system in Group A is anticipated to commence approximately one month after drilling begins in Group B.

During the TCH heater well installation in Group C, surface construction for the TCH wells installed in Group B will commence. Group B system functional testing, pre-final/final inspection, and startup of Group B is anticipated to commence approximately one month after drilling begins in Group C. Surface construction in Group C will be completed as treatment continues in Groups A and B. TCH in Group C is anticipated to commence approximately three months after treatment starts in Group B.

Following the TCH well, TMP, and VMP installations in each Group, the TCH well liners, heaters and junction boxes at the TCH wells and the wiring of the thermocouples at the TMPs will be completed. Power and ground cabling will then be installed from the TCH wells to one of two power control units (PCU). Subsequently, above ground wellhead piping, valves, and hoses from the TCH wells to the vapor and liquid above-ground header piping will be installed, which will then be connected to the carbon-based vapor-liquid treatment equipment.

The vapor-liquid treatment equipment will then be installed on the exterior of the west side of the former ANC building. The vapor extraction and treatment system equipment includes a heat exchanger/condenser, cooling towers, moisture separators, process blowers, vapor phase carbon vessels, and an exhaust stack. The liquid treatment system equipment consists of effluent pumps, bag filters, and liquid phase carbon vessels. A temporary discharge line will be installed from the liquid treatment system to the GWETS for transfer of condensate generated from operation of the ISTR system. A separate electrical power distribution service will be installed for the ISTR system, which will also have an auxiliary power supply installed (generator). Also installed with the equipment and power supply will be system alarms and the remote system control access (programmable logic controller [PLC]).

Once all the ISTR system components are installed in each treatment group and have a power supply, it will be inspected, tested and calibrated along with all ancillary system components prior to start-up and operation, in accordance with the TCH System Commissioning checklists provided as Attachment 1 of the Construction Quality Assurance Plan (Appendix B). Clean (non-potable) water and air will be used to perform functional testing of the process treatment system equipment. During functional testing, the ISTR contractor will identify and correct deficiencies in the heating, extraction, monitoring and treatment equipment, to ensure a smooth transition to full, normal operation.

Upon completion of the functional testing and commissioning of the treatment system, the required start-up activities will occur in a sequential manner as each TTZ is installed. In addition, any needed site asphalt/concrete patching and clean-up from the construction activities will be conducted.

Following approval by the USEPA that remedial goals have been achieved, the ISTR system will be decommissioned from the Site. The TCH wells and TMPs will be abandoned, and the above-ground process treatment equipment will be removed. Additional decommissioning activities include the disconnection of the electric power supply and restoration (patching) of the concrete floor in the Former Molding Room area where the TCH wells were located.

4.2 Preconstruction Meetings

Before any site work, preconstruction meetings will be held. A preconstruction meeting will be held with Albéa representatives prior to scheduling any support or equipment mobilization. Attendees at this preconstruction meeting will include project representatives from PPPI, Albéa, Ramboll and TRS. A Kickoff meeting will also be held just prior to initial drill rig mobilization. Representatives from PPPI, TRS, Ramboll, USEPA, and USACE are expected to attend the Kickoff meeting. The meetings will be used to discuss lines of communication, schedules, health and safety procedures, and general project requirements. Notification will be sent to project representatives at least 2 or 3 weeks in advance of scheduling the preconstruction meetings.

4.3 Site Preparation and Controls

Site mobilization is anticipated to begin in November 2019. Mobilization will include the setup of temporary on-site facilities, setup of contractor support areas, and setup of temporary exterior lighting. The Contractors will begin coordinating the arrival of support facilities, materials, personal protection equipment (PPE), and heavy equipment, as well as the engagement of operators and laborers as needed.

Site orientation training will be conducted, including the establishment of personnel, equipment, safety, and operating procedures that will govern the project. Remedial action contractors will have site-specific training and Rio Tinto safety and critical risk management training prior to working at site. Ramboll and Rio Tinto will conduct this training prior to mobilization. The Rio Tinto HSEQMS program will be followed including daily/shift site inspections, equipment inspections and tailgate meetings.

4.3.1 Site Security

All personnel and visitors will be required to sign in at the Ramboll site construction office trailer located on the south side of the Albéa site before entering any construction or work area. Based on meetings held with Albéa facility personnel, a sign-in procedure has been established as follows:

- On-site TRS and Ramboll personnel will sign-in at the start of each work shift during the tailgate meeting and the sign-in sheet will be kept inside the Ramboll job trailer for access in the event of an emergency evacuation.
- Trained TRS and Ramboll personnel and their subcontractors will be issued contractor badges to be worn at all times when on-site.
- Any visitors will be given visitor training and will be escorted during their visit.
- TRS/Ramboll workers will access the building via west side door of the facility. Equipment will be mobilized to the molding room through the north side overhead door. Drill rigs will traverse to the west overhead door for entrance to the molding room. Construction equipment and materials will traverse to the facility with an escort and in accordance with the Traffic Management Plan (Appendix C).

All personnel working in the Former Molding Room must wear their contractor badges at all times to aid in identification of any non-authorized personnel in the area. Personnel will also be required to sign out prior to leaving.

The entire Albéa property is surrounded by chain link fencing, except at the driveway entrances. The existing GWETS building on the Albéa property is surrounded by permanent fencing and a locked gate. With the exception of the main entrance door, the Albéa exterior building doors along

the west side of the building are typically locked. Traffic warning signs will be posted at the northern and southern contractor staging areas to alert Albéa delivery trucks, employees, and visitors traveling through the area.

Site controls will be established in and around the Former Molding Room for the safety of the remedial workers, Albéa workers and delivery personnel. The doorways leading to the Former Molding Room area will be blocked to prevent Albéa worker/pedestrians or forklifts in the ISTR work area. Caution/warning signage and barricades or caution tape will be installed at all entrances to the Former Molding Room prior to construction. Warning signs will be posted at the doorways into the Former Molding Room area to notify Albéa personnel and visitors to stay out of the work area without escort. An 8-foot wide corridor across the Former Molding Room will be kept free of equipment, cables and materials at all times to allow Albéa forklift traffic through the work area. This corridor across the Former Molding Room will be established and maintained throughout the OU3 RA activities. After installation of the TCH wells, bolt-down bollards will be installed at approximately 10-foot spacing along both sides of the corridor.

The south parking lot area on the Albéa property contains the Ramboll support trailer and sanitary facilities and will be used for designated contractor parking and as a secondary contractor laydown/material storage area. This contractor work area may be fenced for the duration of the OU3 RA activities using temporary metal chain link fencing and privacy screen, depending on Albéa requirements. Temporary metal chain link fencing will not be installed around contractor staging areas located to the north and northwest of the former ANC facility or around TRS's support trailer and tool storage area, both located to the west of the Albéa building.

Concrete jersey barriers and temporary fencing are already present around the existing VIRA SVE blower shed area, and additional concrete jersey barriers and temporary metal chain link fencing will be installed along the traffic-side of the Process Treatment Equipment Area to create one secure area along the western side of the facility building for protection from traffic throughout the duration of the OU3 RA activities. The new electrical equipment area to be located just south of the existing VIRA SVE blower shed area will be secured by concrete jersey barriers and temporary metal chain link fencing. The locations of these areas are depicted on Figure 4.

Chain link fencing will also be installed around the electrical equipment and new electrical power poles P-01 and P-02 to be installed near the existing Jersey Central Power & Light (JCP&L) transmission lines along the western property boundary. The location of this electrical equipment and fenced area is shown on Figure 4 and in the Design Drawings.

4.3.2 Utility Clearance

Prior to beginning drilling, trenching, or other intrusive activities, utility clearance will be coordinated to identify the locations of existing utilities. In addition, maps and record drawings of existing utilities will be reviewed with Albéa site personnel. Prior to the construction of the new electrical utility poles, transformers, and associated underground electrical installations, the Contractor will: 1) call the local One-Call service to mark all public utility locations in the vicinity of the work areas; 2) subcontract with a private utility locator to mark all private lines in the work area; 3) coordinate with Albéa property managers to confirm the location of known utilities on the Albéa site; and, 4) verify the depths of the known utilities by performing "soft digs".

The locations of the identified utility lines will be marked using color-coded survey paint or other field markings before trenching, drilling, or other intrusive activities begin. These markings will be

maintained throughout the duration of construction activities. The field construction manager will be notified immediately of any unidentified utility encountered in the work area and precautions will be taken to protect the utility. Site controls will be in place (signage and construction equipment/vehicle routes) to establish safe distances from existing overhead power lines at the Albéa site.

Prior to drilling, the proposed locations of the TCH wells, TMPs, and VMPs will be marked at the site by Geod Corporation, a New Jersey-licensed surveyor in accordance with N.J.S.A. 51:3-7. The horizontal location will be established within the New Jersey State Plane Coordinate System, based on the North American Datum of 1983. The elevation of the wells will be established relative to North American Vertical Datum of 1988. The proposed TCH well, TMP, and VMP locations will be checked for underground utilities by a private utility locator prior to drilling with the upper few feet of the boring advanced by soft digging.

4.3.3 Support Facilities

Upon mobilization, the following temporary facilities will be furnished at the Site: furnished field offices, sanitation/hygiene facilities (separate men and women), waste containers, first aid equipment, spill control kits, fire protection equipment, and PPE. These facilities will be maintained throughout the project and will be removed after completion of all OU3 RA activities, including system decommissioning. The following services will also be provided: electricity, lighting, wireless internet, drinking water supply, sanitary waste disposal, and traffic management. The Ramboll support trailer is already present at the south end of the Site, and electric, HVAC, sanitary, and wireless internet services are already present in this trailer. A field office trailer for TRS will also be established at the west side of the Albéa building, and this trailer will be equipped with electric, HVAC, and internet services. Sanitation/hygiene facilities will also be installed near the TRS support trailer.

4.3.4 Material Staging and Transport

Equipment and material staging areas will be constructed at the northern and southern ends of the Albéa property. The primary laydown areas for construction materials will be at the north end of the property (Staging Area #1) and along the existing northwestern property fence (Staging Area #2). A secondary laydown area will be located near the Ramboll support trailer in the south parking lot of the Site. Waste material roll-off boxes will be staged in the primary laydown areas (Staging Area #1 and #2). The locations of the contractor laydown areas are shown on Figure 4.

The Contractor will be procuring materials and supplies for well installation from vendors with warehouse facilities in relatively close proximity to the Site to allow for deliveries of materials as needed for the project. The necessary materials and equipment transported to the Site will be staged on the primary and/or secondary laydown areas. Material and equipment deliveries to the Site will follow the route designated in the Traffic Management Plan provided in Appendix C. Signage will be installed as noted in the Traffic Management Plan to direct Albéa delivery traffic safely through the work area and to direct site employee vehicles around the layout/staging areas.

The TRS support trailer, process equipment trailers, and tool storage area will be located on the west side of the Albéa building as shown in the Final 100% Design Report and on Figure 4. For the process treatment equipment installations, TRS' equipment will be shipped from its storage facility, which will allow for sequencing of equipment deliveries as equipment is needed for installation at the Site.

At the Site, materials and equipment will be transported into and out of the facility through an overhead door on the west side of the Albéa facility. The location of the overhead door to be used is depicted on Figure 4. A temporary gravel ramp will be installed at the location of the overhead door to facilitate equipment access and egress on the west side of the Albéa facility. An interior equipment transport route will also be established for transporting materials and equipment from the overhead door area to the Former Molding Room, and this interior route is shown on Figure 5.

4.3.5 Exterior Lighting

Exterior lighting will also be installed at the west and north sides of the facility building, as the TCH well drilling activities will be conducted during second and third shifts. The Contractor will provide three diesel-powered, trailer-mounted temporary light towers. One light tower will be placed to the west of the building for security during night-time work, and two light towers will be placed to the north of the building to illuminate the contractor laydown areas where equipment and materials will be staged.

4.4 Electrical Power Supply Installation

A separate electrical power supply service will be installed from one of the two existing Jersey Central Power and Light (JCP&L)/First Energy 34.5 kilovolt (kV) three-phase overhead transmission lines that cross at Route 31 North and continue west along the south side of the Albéa property. The electrical service for the ISTR system will be connected to the northern 34.5 kV transmission line to avoid disrupting the power quality that currently serves the Albéa facility.

The designed electrical supply plan has been submitted to First Energy for review. Upon approval of the plan, a new power pole will be installed by an electrical contractor near the existing First Energy 34.5 kV overhead transmission line, and the north circuit will be connected by First Energy to create a new 34.5 kV customer-owned primary service. The new customer-owned 34.5 kV pole will be completed with a group operated switch to feed a second pole with a fused disconnect switch and metering cabinet with ground mat and loop. The utility pole locations will be cleared for underground utilities by Geod Corporation, prior to placement.

The electrical power service will be routed overhead to two 2,500 kVA transformers (T-1 and T-2) located adjacent to the ISTR treatment equipment staging area and south of the existing VIRA SVE blower shed area along the western exterior wall of the Albéa facility. Transformer T-1 will serve the ISTR system by feeding two separate PCU's for ISTR system operation, while transformer T-2 will be optional depending on the final power demand needed for the project. The ISTR electrical power distribution service installation details are provided in the design drawings.

The ISTR contractor's licensed electrician will run secondary conductors from breakers off the main PCU's to downstream panel boards that feed the heater and process equipment. All equipment will be installed, wired, and commissioned in accordance with the National Electrical Code. The electrical subcontractor's certifications are provided in Appendix A.

Backup power to operate the above-ground treatment system components is currently planned via an automatic transfer switch utilizing a 150-kilowatt (kW) diesel-powered generator. The generator will be mobilized to the site prior to system start up and located adjacent to transformers T-1 and T-2, west of the Albéa building.

4.5 Facility Pre-Construction Condition Survey

Prior to the construction of the OU3 RA, a facility pre-construction condition survey will be completed. Visual inspections of interior structural elements in the ISTR area and exterior

pavement/surface conditions where construction activities will occur will be conducted to document their condition prior to construction. Interior structural elements to be inspected include, but are not limited to, walls, floor slab, doorway headers, and wall and column footings. A photolog will be prepared for the pre-construction condition survey.

Visual inspections will be completed routinely throughout the construction and operation of the ISTR system. Each inspection will be documented in a photolog, and any signs of excessive settlement or movement of interior structural elements will be reported to the Project Engineer. The visual inspections are to be completed according to Section 02 21 13 of the Technical Specifications.

4.6 Settlement Monitoring Benchmarking

A baseline survey will be conducted to set benchmarks and elevation survey control points within the Former Molding Room of the ANC building, where subsurface heating will occur. The baseline benchmarking survey will establish a minimum of 25 elevation monitoring locations within the footprint of the treatment area, with bench points co-located with structural building features such as columns and at the base of load-bearing walls, where feasible. A set of control points will also be established well outside the influence of the ISTR system. The benchmarking will be conducted in accordance with Section 02 21 13 of the Technical Specifications. The locations of these elevation monitoring points are depicted on Figure 6.

The baseline survey will be conducted prior to ISTR system startup and operation. During system operation and after the active remediation period, elevation survey measurements will be collected according to the following schedule:

- First 60 days of active remediation (Group A heat-up period) (Days 1 – 60): One round of measurements
- Days 61 – 478 (during system operation and sequential heating of Groups A, B, and C): One round of measurements taken approximately every 60 days during operation (for a total of 8 measurement events)
- Days 479 – 525 (post-remediation): One round of measurements taken approximately every 30 days (for a total of 2 post-remediation measurement events)

In the event that the monitoring results show a continuing trend of differential settlement, the measurement frequency will be increased to approximately every 30 days. The survey data will be reviewed by the Project Engineer, and a log of the survey data for each measurement round will be maintained.

4.7 Thermal Remediation System Installation

The ISTR system is comprised of several components to be installed at the Site. The TCH wells, thermocouples, and VMPs will be installed within the Albéa facility using roto-sonic drilling methods. The TCH wells will supply heat by thermal conduction to the subsurface, and each heater boring will be equipped with VEWs to extract the vapors. The thermocouples will be used to monitor subsurface temperatures. The VMPs will be used to collect sub-slab vacuum and PID measurements to verify that the ISTR vapor extraction system remains effective in preventing soil vapors from migrating to the upper vadose zone soils. The vapor and liquid process treatment equipment will be installed along the western exterior side of the Albéa facility. The ISTR process conveyance piping and electrical equipment will be installed within the facility to convey the extracted vapors and provide electrical power, respectively. Condensate discharge piping will be constructed to discharge treated condensate to the on-site GWETS for injection. Additionally, an

indoor air monitoring system will be installed for operation during ISTR system operation. These components of the thermal remediation system installations are discussed further in the following sections.

4.7.1 TCH Wells

Fifty-seven (57) vertical and 121 angled TCH wells with co-located vapor extraction wells (VEWs) will be installed as part of the ISTR system. The locations of these TCH wells are presented in design drawing C102 (Wellfield Layout). Due to Albéa facility constraints, the drilling work to install the TCH wells will be conducted during second shift, which includes working at non-routine hours (e.g., late afternoon and evening). The Contractor is scheduled to operate sonic rigs on a 10 day on 4 day off schedule over a two week period. At the start of drilling, there will be two rigs operating during a single second shift until the first 8-day rotation is complete (shortened by Thanksgiving holiday). Subsequently, a 3rd and if conditions allow 4th rig will be added and will also operate during second shift over the same two week rotation. The sequencing of the TCH well drilling activities is presented in Table 1. Ramboll will provide oversight for casing, screen, sand pack, grout and vapor points installation at the depths defined in design drawing C103 (Typical Well Construction Details).

Following the utility clearance, all vertical TCH well locations will be cored through the concrete slab with the sonic rig. Approximately six locations will be cleared before drilling starts and the remainder will be done as the drilling operation progresses. Small rectangular trenches will be saw cut at the angled TCH well locations. Wet saw cutting methods will be used to control dust, and the cut concrete will be removed. The borings for the TCH wells will be completed using roto-sonic drilling methods. Advancement of the borings will be completed using a 6-inch override casing to the terminal depth of the well boring. In this configuration, 5-foot and 10-foot soil core barrels of an appropriate size will be advanced to collect the soil core. Soil removed from the core barrels will be containerized and transported to a roll-off contained staged on the primary laydown area.

The stainless steel heater well casing sections will be welded using a tungsten inert gas (TIG) welder by a TRS-qualified welder as they are installed. The heater elements and associated cabling will be installed once the TCH wells have been completed. An electrical junction box will be installed at each TCH heater well location and electric conductors from each junction box will be routed to the PCU.

The azimuths and angles of inclination for angled TCH well installation were determined by utilizing the EVS model to determine the depths of treatment. TRS calculated the well angles required to reach those treatment depths based on the EVS model. Prior to drilling, each TCH well location will be staked/marked in the field by a professional surveyor (Geod) using the coordinate system and vertical datum established for the project. For each angled TCH well, the azimuth angle of the borehole will be marked at the boring location and an offset marker will be placed referencing 0 degrees north to be used for subsequent borehole alignment verification. In addition, a measurement of the reference azimuth angle with respect to true north will be established during the survey. The reference azimuth angles will be marked using the established site coordinate system with 0 degrees representing coordinate north, 90 degrees representing coordinate east, 180 degrees representing coordinate south and 270 degrees representing coordinate west, consistent with the EVS model coordinate system. Prior to well installation, the drilling angle from horizontal or borehole inclination and azimuth angle will be measured in the field using a DeviAligner™ portable surface alignment tool. The DeviAligner™ is a portable battery operated north seeking gyroscope alignment system designed to make and record highly accurate

measurements of true north, inclination, and roll angles by attaching the instrument to the drill casing before advancement of the drill string.

Ramboll will verify that the angled borings are installed within an acceptable tolerance such that they do not substantially deviate from the borehole inclination, azimuth angle and location coordinates identified in the 3D EVS model and final design drawings/specifications. Borehole surveying methods will be used to measure the direction and inclination of the angled boreholes, enabling the calculation of trajectory coordinates while the TCH wells are being installed. The borehole surveying method will utilize a DeviFlex™ survey tool which is a non-magnetic multi-shot survey instrument that is used inside the drill string. The DeviFlex™ survey tool is not affected by magnetic disturbance and can be used in all types of rock formations, in cased boreholes and in boreholes adjacent to steel or other objects that locally alter the earth's magnetic field. The DeviFlex™ is an electronic instrument that uses tri-axis accelerometers to measure the absolute inclination and the rotation angle of the instrument axis at any given position and strain gauge sensors to detect the deflection over the length of the instrument. The sensor data obtained during a borehole survey is stored in an internal memory within the unit and is downloaded when the tool is retrieved. The surveying equipment includes a PDA and software to collect and interpret the data.

The instrument will be deployed directly inside the TCH casing to facilitate use of the tool with standard parts fitting in BWL, NWL and HWL drill string. A wireline is attached to the top of the DeviFlex™ and secured to a spool for measurement of instrument depth and for safe deployment and retrieval. The survey is generally performed by placing the DeviFlex™ at a given depth. Once the instrument is installed to depth the tool will take a measurement to read and record the sensor data. Once recorded the survey tool is raised or lowered to the next depth and a new measurement is recorded. Together with the user inserted depth value, the sensor data is processed into azimuth, inclination and borehole coordinates. As the DeviFlex™ measures the bend of the instrument between three centralizers, the depth interval between measurement points must be shorter or equal to the length of the instrument unit (4m/13ft). As a result, several measurement points will be collected over the length of each angled TCH well to determine its alignment. During installation of the angled TCH wells, up to three deployments of the DeviFlex™ survey tool will be made at each TCH well to confirm the boring alignment is on target.

After retrieval and removal of the instrument from the borehole, a communications cable is connected to the PDA to display and download the coordinates of the borehole measurements along with a profile of the hole. The results are instantaneously displayed on the PDA for determination of borehole alignment. Each angled TCH well survey and profile will be evaluated with respect to the maximum established borehole deviation tolerance of 4 feet in any direction (based on the thermal model requirements). After verifying the borehole alignment measurements/coordinates are within tolerance, TRS will confirm the installed annular material depths, screen depths, and heater well liner depths.

To confirm the extent of TCE in soil >1 mg/kg in the areas to the north (north of PDI-SB33) and south (south of PDI-SB32) of the identified impact area, vertical soil samples will be collected from within the main production area during the Christmas Holiday plant shutdown. One to two borings will be installed at the north and south ends of the plume edge for a total of two to four borings. The proposed locations of the initial soil borings to the north and south are shown on Figure D-3 of the Field Sampling Plan in Appendix D. Soil samples will be collected between the depths of 75 to approximately 120 feet bgs from each boring using the same sampling procedures and methodology as described in the Pre-Design Soil Sampling and Analysis Plan (Ramboll, 2018). Sampling will be conducted in accordance with the Field Sampling Plan, which is provided as

Appendix D. Samples will be sent to Test America in Edison, NJ for TCE analysis. These data will be used to verify the EVS modeled extent of the TCE impacts south of PDI-SB32 and north of soil boring PDI-SB33, and to ensure that the remedy is sufficiently designed to treat the soil volume exceeding 1 mg/kg at these locations. TCH well borings will be drilled without sampling.

The wellfield layout for the Site utilizes a heater spacing of approximately 15 to 20 feet, varying with locations and depth depending on the installed/drilled angles, and based on practical limitations for installation. The wellfield layout is presented in the Design Drawing C-102. Vapor extraction wells will be co-located with each heater, with vapor capture from the shallowest heater in each fan, and at angled borings not within a fan group screened across the depth of the TTZ. Co-located vapor extraction wells for the vertical borings and for fan heaters not at the shallowest angle of the fan group will be screened across the top 20 ft of the TTZ. The purpose of the vapor extraction points is to extract contaminant mass from the TTZ as the mass is volatilized by the TCH wells. To attain the goal of 1 mg/kg for TCE, the TTZ will be heated to temperatures between 87 and 100°C, with an operational target of reaching a temperature of 90°C in at least 95% of the thermocouple locations inside the TTZ.

The TRS heater design incorporates the use of a "cold pin" to reduce heating of soils above the treatment zone. The cold pin will only heat up at about 1/14th the rate of the heater element and will generate only a small amount of heat in the upper 60 feet of soil above the TTZ. To reduce heat in the "cold pin" section, the heater element will be constructed using a copper rod to carry the electrical current through the portion of the heater element above the TTZ. Due to the lower electrical resistance of copper versus nickel, the heat generated over the "cold pin" section is significantly reduced in the upper 60 feet of soil. This design saves energy and prevents the soil below the building floor from being heated.

4.7.2 Thermocouples

Seven (7) additional temperature monitoring points (TMPs) will be installed as part of the thermal remediation system installation. Eleven (11) TMPs were previously installed during the pre-design investigation activities. The seven TMPs will be installed within the TTZ at the locations shown on Drawing C102 – Wellfield Layout in the Final 100% Design Report (Ramboll, 2019). The TMPs will be completed using roto-sonic drilling methods, with a 1.5-inch diameter carbon steel casing installed at each location. A flush-mounted well box will be installed at the surface of each TMP. One of the TMPs to be installed is located in the MPA of the Albéa facility. This TMP, T-14, will be installed during the facility's holiday shutdown scheduled to occur in late December 2019 to early January 2020.

Thermocouples will be installed at each TMP after the drilling activities are completed. The thermocouples will be installed at approximately every 10 feet in the vertical interval from just below the surface of the building slab and transitioning to every 5 feet in the vertical interval from the top to the bottom of the TTZ to monitor heating progress. The thermocouples in the Former Molding Room will be hardwired to a repeater box and data is automatically collected using temperature logger software, organized in a database and posted real-time on a project specific webpage. Temperatures from the thermocouples in the MPA will be measured using a manual instrument or automatically collected from thermocouples equipped with wireless technology and temperature logger software.

4.7.3 Vapor Monitoring Probes

Two (2) additional VMPs will be installed as part of the thermal remediation system installation. Three (3) VMPs were previously installed during the pre-design investigation activities. The

existing VMPs (VMP-1, VMP-2 and VMP-3) are located within the Group C heaters in the FMR. The additional VMPs will be installed within the Group A heaters (VMP-4) and Group B heaters (VMP-5) within the MPA. VMP-5 will be collocated with temperature monitoring point T-14. The two additional VMPs will be installed at the locations shown on Figure 7.

Each of the additional VMP borings will be installed to a total depth of 25 feet bgs and contain three monitoring ports (screens) at 5, 15, and 25 feet bgs. Each vertical monitoring port will be sequentially labeled using the "A" identifier for the shallowest, uppermost port, "B" for the next port in the sequence below and "C" for the bottom port. The intervals between the monitoring ports will be sealed with cement grout to isolate the screens and to prevent short-circuiting over the vertical profile. Each individual monitoring port will consist of a one-half-inch diameter stainless steel screen constructed by Geoprobe Systems® that is approximately 6 inches in length and connected to Fluorinated Ethylene Propylene (FEP) tubing that extends to the surface. The FEP tubing connected to each port will be colored to identify its location/depth interval (Green, Red, and Blue for the three depth intervals [A though C] at each VMP) and a ¼-inch stainless steel ball valve will be connected to the FEP tubing to facilitate connection to the necessary monitoring equipment. The ball valves will be protected in an 10-inch diameter flush-mounted steel protective compartment concreted in-place.

The two additional VMPs are located in the MPA of the Albéa facility, so they will be installed during the facility's holiday shutdown scheduled to occur in late December 2019 to early January 2020.

4.7.4 Process Treatment Equipment

The process treatment equipment includes the vapor extraction and treatment system and the liquid treatment system. The process treatment system equipment will be installed near completion of the drilling activities for the Group A heater wells as described in Section 4.1.

Vapor Extraction and Treatment System

The vapor extraction and treatment system consists of the following major components: vapor heat exchanger or condenser; moisture separator; process blowers; vapor phase carbon vessels; cooling tower; and exhaust stack. The system components will be delivered to the site on a flat-bed trailer, and an all-terrain forklift will be used to offload the process equipment and move each component to its designated location along the west side of the facility building. The location of the process treatment equipment is depicted on Figure 4, and the system configuration is presented on Drawing M101 in the Design Drawings.

Once installed, the Contractor's electrical subcontractor will complete the necessary electrical installations, and the necessary piping and other ancillary installation connections will be completed in accordance with the Design Drawings.

Liquid Treatment System

The liquid treatment system consists of the following major components: bag filters; liquid phase carbon vessels; temporary effluent holding tanks and transfer pumps. The system components will be delivered to the site on a flat-bed trailer, and an all-terrain forklift will be used to offload the process equipment and move each component to its designated location along the west side of the

facility building. The location of the liquid treatment system is depicted on Figure 4, and the system configuration is presented on Drawing M101 in the Design Drawings.

Once installed, the Contractor's electrical subcontractor will complete the necessary electrical installations, and the necessary piping and other ancillary installation connections will be completed in accordance with the Design Drawings.

4.7.5 ISTR Process Conveyance Piping System

The process conveyance piping system to route extracted vapors from the TCH wellheads to the process treatment equipment will be installed following TCH well completion at each of the three heater groups. A ball valve will be installed as part of the TCH wellhead piping assembly. The wellhead piping will be connected to a temperature- and chemical-rated hose to allow for thermal expansion during operation. The vapor manifold piping will be installed on the floor and/or supported on uni-strut (or similar) pipe stands within the Former Molding Room area. The vapor manifold lines will run overhead and be routed to the exterior of the building through the western wall of the Albéa building. Scissor lifts will be used during the overhead piping installation and working from heights safety protocols will be followed during the completion of this work. The primary manifold will be equipped with drains at the low points of the piping to allow for condensate generated due to ambient cooling to be pumped to the liquid treatment system. The process conveyance piping system layout is presented in the Design Drawings (Drawing M102).

4.7.6 ISTR Electrical Equipment

Following TCH well completion, the power and ground cabling to the heater wells and termination of cabling to a group of transformers will be installed inside the Former Molding Room area. The individual heater circuits will be controlled at the two PCUs located on the western side of the Albéa building. The electrical cabling to each individual TCH well will be installed on the floor of the Former Molding Room and routed to a centralized transformer location where they will be bundled together to run overhead on cable trays. The bundled overhead cables will exit the building on the western wall of the facility. The ISTR electrical equipment layout is shown in the Design Drawings.

The electrical equipment layout for the OU3 RA construction incorporates the required clearance for normal panel access by qualified personnel per NEC Code Article 110. All of the Contractor's equipment will be installed per NFPA 70 National Electric Code Article 110.26 (Spaces Around Electrical Equipment), included but not limited to this Article are conditions of clearances to Electrical Equipment and Personnel Doors.

After completion of NFPA 70E Arc Flash study to assist with compliance of OSHA 1910 Subpart S and OSHA 1926 Subpart K, additional safety boundaries will be added if required. Building access via man door or overhead has been considered with this layout. Appropriate barricade fencing will be incorporated to limit access. In the event that servicing the equipment requires additional safety clearance, then access to the man door or overhead door on the Albéa building may be temporarily restricted.

4.7.7 Condensate Discharge Piping System

To facilitate the transfer of liquids from the liquid treatment system holding tank to the on-site GWETS, a temporary condensate discharge line will be routed above-ground from the treated condensate holding tank to the process influent tank located inside the GWETS building. The temporary discharge line will consist of a 1-1/4 or 1-1/2-inch diameter PVC or HDPE conveyance pipe that is insulated and heat traced for cold weather operation. This conveyance pipe will be installed by the Contractor and located along the western side of the Albéa building. Where the

conveyance pipe crosses the west driveway, the pipe will be buried in a shallow excavation across the driveway. Piping alignment shall consider the potential for piping shift or expansion due to temperature fluctuations. Effluent offloading pumps will be installed adjacent to the effluent holding tank to transfer the liquids.

4.7.8 Indoor Air Monitoring System

Indoor air quality will be monitored on a real-time basis during ISTR system operation at locations provided in the Design Report. Continuous indoor air monitoring will be performed using an unmanned-remotely controlled gas chromatograph (GC) equipped with an electron capture detector (ECD) and multiport analyzer provided by Groundswell Technologies (VaporSafe™). The VaporSafe™ ECD system will be installed along the northern wall of the Former Molding Room, with a total of ten separate sample collection tubing lines installed throughout the Former Molding Room and Main Production areas. The sample collection locations are shown on Figure 7. The VaporSafe™ system components will be installed, field tested, and calibrated in accordance with Section 11 11 19 of the Technical Specifications.

4.8 Equipment Decontamination

Construction equipment will be decontaminated as specified in the Technical Specifications. The Contractor will establish equipment and personnel decontamination facilities at the Site. An equipment decontamination pad will be constructed in the northern contractor laydown area (Laydown Area 1) so that all decontaminated fluids can be fully contained and captured. The decontamination pad will be approximately 8-feet by 12-feet (minimum) in size and constructed of a wood frame lined with heavy mil plastic.

Subsurface drilling equipment will be decontaminated by the Contractor before equipment is mobilized to the Site, prior to drilling a boring where sampling will be conducted, at the end of each working day, and prior to leaving the Site. Steam cleaning with a high-pressure washer will be used for decontaminating drilling equipment. The Contractor will provide plastic totes for the containerization and storage of decontamination fluids at the Site.

All equipment, tools, or other items potentially coming into contact with impacted soil will be decontaminated at various times during the progress of the work and completion of the work. During construction, decontamination will occur prior to removing contaminated equipment, tools, or other items from the work areas, as needed. Field equipment decontamination will be conducted in accordance with the Quality Assurance Project Plan, Revision 9 (Ramboll, 2018a).

4.9 Waste Handling and Disposal

Wastes generated during OU3 RA construction activities will be managed in accordance with the Waste Management Plan, which is provided in Appendix E. Wastes anticipated as part of the ISTR construction activities include construction debris, soil cuttings, decontamination rinseate, and drilling water. The construction activities are not expected to generate hazardous wastes. Should a hazardous waste stream be generated, an addendum to this plan will be submitted to the USEPA.

Coordination with the transportation contractor and disposal facility will be conducted by Ramboll in coordination with the Contractor. Ramboll will be responsible for preparing waste profiles for acceptance by the off-site disposal facility. The Contractor will be responsible for the waste transportation and off-site disposal.

Soil cuttings will be temporarily containerized in 2-yard soil hoppers in the drilling area. The drums will be hauled each day and transferred to roll-off boxes temporarily staged in the contractor staging area to the north of the building (Laydown Area 1). Drilling water will be containerized in plastic totes in the drilling area. The totes will then be transported to the on-site GWETS for treatment.

Decontamination rinsate will also be containerized in totes provided by the Contractor for treatment in the on-site GWETS. Disposable PPE used for sampling activities will be contained in trash bags and disposed of as general refuse.

Following receipt of the waste sampling results, advance notification of waste disposal activity will be provided to the USEPA prior to off-site shipment to the approved disposal facility. Shipments of the drill cuttings off-site will be manifested to meet state and federal requirements and will be managed in accordance with the Waste Management Plan contained in Appendix E.

4.10 Progress Meetings

Weekly progress meetings will be held with the Contractor's Project Manager, Ramboll Site Supervisor, and Ramboll Project Engineer during the construction of the ISTR System. PPPI's Project Coordinator for OU3, Ramboll Project Director, and USEPA may also attend some or all these weekly progress meetings. The weekly progress meetings will be scheduled by the Ramboll Project Engineer. Weekly progress meetings will discuss construction related items including, but not limited to, project status, review of CQA observations, management of change, field modifications, schedule, and overall project implementation progress.

5. CONSTRUCTION QUALITY CONTROL

CQA activities will be coordinated by Ramboll. Project monitoring will be performed based on a combination of the review for general compliance with the Final (100%) Design for OU3, submittal review, periodic project meetings, and on-site observation. The pre-construction meeting will include reviewing of the CQA roles and procedures prior to the start of the construction activities. Field CQA personnel will attend daily site meetings and participate in weekly progress meetings. The CQA activities will be coordinated as described in the CQA Plan, in Appendix B, and the following sections describe the quality control activities, procedures for field modifications, and pre-final and final inspections.

5.1 Quality Control Activities

As part of the CQA activities, Ramboll will review technical submittals and conduct on-site observation and review of the Contractor's activities. Daily/shift meetings will be attended by the on-site crew to discuss day-to-day operations, daily schedule, health and safety matters, coordination of construction activities, and general project status.

The Contractor will conduct most of the CQA testing with oversight by the CQA officer or designated alternate. The CQA officer and/or construction managers will be responsible for scheduling observation of testing, installation oversight, inspections and for review of Contractor submittals. Field CQA may also be conducted by subcontractors engaged for their specialized knowledge of the equipment/materials to be inspected or tested.

Other CQA activities to be conducted as part of the OU3 RA will include:

- Review of submittals provided by the ISTR contractor.

- Review equipment and material deliveries to ensure they match the project specifications, drawings, and/or submittals.
- Verification that the angled borings are installed within an acceptable tolerance such that they do not substantially deviate from the locations/coordinates identified in the 3D EVS model.
- Data validation of laboratory results, such as TCE analysis of soils and summa canister air testing.
- Process piping leak testing using potable water according to Specification 40 10 00 of the Design Report.
- Periodic surveying of the settlement points before construction, during ISTR system operation, and after ISTR shutdown, as required in Technical Specification 02 21 13.
- Photographing of significant component installations.
- Reporting of testing results in the weekly progress meeting.

As part of the CQA activities, documenting the calibration and functional testing of the mechanical systems, electrical systems, instrumentation and system controls will be conducted. The checklists to be used are provided in the CQA Plan in Appendix B. Upon successful completion of functional testing, system commissioning/start-up will be scheduled. CQA activities will include verification that the tanks/vessels, heat exchangers, and cooling tower are filled to startup levels, alarms and interlocks are working, sampling procedures are in place, and safety procedures are utilized.

5.2 Field Modification Procedures and Documentation

The procedures for addressing field modifications and documentation are provided below:

- Proposals for field modifications will be submitted in writing (email is acceptable) by the Remedial Construction Contractor to Ramboll (Project Engineer or PPPI's designated representative), which has the authority and responsibility set forth to initiate field change orders with Ramboll and PPPI for approval.
- Field modifications will fall into two general categories, minor field modifications and major field modifications. Ramboll will discuss the requested field change with USACE to seek concurrence on categorizing the modification as a minor or major change and to provide additional information that may be requested to make this determination. Concurrence by the USACE on categorizing the field modification may be accomplished via e-mail or by initialing the change directive.
- Minor field modifications will be defined as any modification that does not significantly deviate from the approved design, material and performance specifications, or permit requirements of the project as determined by the Design Engineer and/or the Project Engineer. The submittals will include a discussion of any cost implications and if any cost modification to the project is necessary. If acceptable, the Project Engineer or PPPI's designated representative will prepare a change order directive and, if necessary, a cost change order. The Contractor will not proceed with the minor modification until an approved change order directive/change order is received from Ramboll.
- Major field modifications will be defined as any modification that significantly deviates from the approved design, material and performance specifications, or permit requirements of the project as determined by the Design Engineer and/or the Project Engineer. Proposals for major field modifications, will be submitted in writing by the Remedial Construction Contractor to Ramboll (Project Engineer or PPPI's designated representative), and if acceptable, will be

forwarded to the USEPA and USACE for review. The submittals will include a discussion of the proposed modification and any supporting information such as drawings, calculations, plan modifications, equipment/ material specification sheets, manufacturer's data sheets, etc. that are necessary to facilitate review and approval of the proposed modification by USEPA and USACE. Upon approval of the modification by USEPA, Ramboll will prepare a change order directive/change order for the modification to be implemented by the Remedial Construction Contractor. The ISTR Contractor will not proceed with any major modification until an approved change order directive/change order is received from Ramboll.

- As construction proceeds, any major or minor modification that differs from the approved design will be recorded on the applicable "Record Set" of the design drawings that were "Issued for Construction". The "Record Set" is a redline document that will be maintained by Ramboll which documents deviations to the "Issued for Construction" drawing set. Changes to the "Record Set" will be dated and initialed by the Site Engineer and/or Remedial Construction Contractor. In the event a major modification submittal is necessary, any existing "Record Set" mark-ups that have already been completed may be incorporated into documents provided to USEPA and USACE for review of the planned modification. All field changes will be recorded in a manner to highlight the modification(s). These highlights will be retained by Ramboll throughout the construction of the project, regardless of the number of iterations. In addition to mark-ups of the construction "Record Set," all certifications, manuals, and other manufacturer documentation will be retained.
- Each change directive and the "Record Set" of drawings will be kept on file for record keeping purposes and for documenting the modification(s) in the Remedial Action Report and for preparing "As-Built" plans.

A special meeting may be held with a problem or deficiency developed. A summary of the meeting including a plan for corrective measure to address identified deficiency and follow-up actions will be documented by the CQA Officer. Following implementation of the identified corrective measures, the CQA Officer shall report to Project Engineer on the effectiveness of the corrective actions and document the measures taken for the project record.

5.3 Pre-Final and Final Inspection

At the completion of construction at each treatment group, the CQA officer or Project Engineer will schedule a pre-final inspection with USEPA. The pre-final inspection will be after successful functional testing of the equipment has been completed as approved by the Project Engineer. The USEPA and their representatives from the USACE will be notified in advance of the schedule for conducting the pre-final inspection.

The ISTR contractor will correct deficiencies noted by USEPA during the pre-final inspection and notify the Project Engineer. Upon completion of corrective actions required during the pre-final inspection, a final inspection will be scheduled with the USEPA and the USACE representatives. The start-up will not be conducted until construction is deemed complete by approval of the final inspection by the USEPA.

6. SYSTEM FUNCTIONAL TESTING AND STARTUP

Once construction activities are complete at each treatment group, operational readiness review will be held at the Site. In this meeting, the system commissioning, startup, and operational activities to be performed will be presented. The system start-up procedures are described in the project OM&M Plan in Appendix F.

Some of the commissioning tasks to be observed are included in the Construction, System and Equipment Checklists provided in the Design Report. In addition, the CQA representative will ensure that the following are completed/operational in accordance with the Design Report:

- Alarm and interlock functions;
- Alarm notification functions;
- Transfer lines have been leak-tested;
- Liquid tanks, vessels, heat exchanger, cooling tower are filled to start-up levels;
- Carbon beds are flooded and de-aerated;
- Health and safety plans are reviewed by operator(s); and
- Sampling and measurements are planned as required in the OM&M Plan. The Commissioning and startup sampling will be conducted by TRS with the assistance and oversight by Ramboll. The Ramboll CQA officer or designated alternate will document the startup sampling and measurements.

Following functional testing, the pre-final and final inspections will be scheduled and, after any deficiencies are corrected, startup of the ISTR will commence. Following startup, all final record documents will be prepared and submitted by the contractor to the Project Engineer.

7. SYSTEM OPERATION, MAINTENANCE AND MONITORING

As required by the SOW, a revised draft of the OM&M plan is provided with the RAWP (Appendix F). The OM&M Plan provides operator-level guidance for normal day to day operations, normal maintenance, data collection and management, start-up and shutdown procedures and initial field troubleshooting and operation contingency plans. The OM&M Plan provides information and procedures that will be used throughout the TCH operation period. In addition, the plan provides guidance on data management and record keeping, safety, maintenance, and troubleshooting. TRS will be responsible for operating, maintaining, and monitoring the project system during the TCH treatment system construction, operations, and demobilization phases.

The project team will consist of TRS representatives who have been integral in the planning, development and management of the project implementation. The Project Engineer, Technical Director and Principal-in-Charge are defined in the OM&M Plan. Figure 1 of this RAWP provided the lines of authority for this project. OM&M staff training requirements for specific tasks are discussed in the OM&M Plan.

Included in the OM&M Plan (Appendix F) is the schedule for daily, weekly, and monthly liquid and vapor sampling. Sampling procedures and sampling port locations are also included. The analyses planned for each monitoring task are provided in the text of the Plan. Monitoring of the indoor air via the VaporSafe™ system is explained in the OM&M Plan. Post-remediation soil sampling system operations procedures during the soil confirmation sampling are noted in the attached OM&M Plan; however, the specific soil sampling procedures are provided in the Final (100%) Remedial Design Report. If appropriate, modifications of the OM&M Plan may be submitted to the USEPA for consideration upon completion of construction.

Long-term groundwater sampling in the OU3 Study Area is discussed in the MNA Work Plan (Ramboll Environ, April 2017). Long-term indoor air monitoring is discussed in the OM&M Plan for

the Vapor Intrusion Response Activities (Ramboll Environ 2015). Based on the result of the ISTR, modification to the indoor air monitoring schedule may be requested.

8. HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION MEASURES

8.1 Health and Safety Plan

The Site-specific Health and Safety Plan (HASP) for the project includes the work activities described in this RAWP and is provided as Appendix G.

8.2 Rio Tinto Health and Safety Program

PPPI (Rio Tinto) utilizes a corporate health and safety program based on risk elimination and reduction. This project will be completed in compliance with Rio Tinto's HSEQ MS, which requires specific safety protocols and the identification of site-specific hazards and assessment to qualitatively evaluate risk.

All site workers will be trained on the site-specific HSEQ MS before starting work on the site. The safety protocols required by the HSEQ MS include daily tailgate meetings, daily vehicle inspections, daily site inspections, daily equipment inspections and some pre-work permits. A safety officer will be assigned to each work shift during construction to facilitate the program and monitor safety needs.

A qualitive risk assessment has been conducted, and hazard scenarios with associated moderate and high-risk ratings have been identified for the upcoming work. The assessment included identification of project risks in the following categories: health, personal safety, environment, community, compliance, and reputation. The identified risks will be address during construction and system operation.

In addition, the HSEQ system provides Health, Safety, and Environment Performance Standards and written procedures that provide the minimum HSE requirements that the ISTR contractor must meet when conducting work on Rio Tinto Sites.

This project will also utilize the Rio Tinto Critical Risk Management (CRM) program. This program is designed to eliminate fatalities in the work place through identification of critical risks, identification of critical controls (controls necessary to eliminate or reduce the critical risk to an acceptable level), and verification that the required critical controls are in place prior to the start of and through the duration of a given field task. There are three components of the CRM program:

- Critical Control Checklists (CCCs) are to be completed for each task whether a critical risk(s) is present.
- Critical Control Field Verification CCFV is completed by Rio Tinto or an approved Ramboll Site Safety Officer (SSO).
- Critical Control Verification Standard (CCVS) is completed by a Rio Tinto General Manager once per month.

8.3 Indoor Air Pollution Prevention

Exhaust purifiers (scrubbers) will be connected to the exhaust of each drill rig during indoor drilling activities. The scrubbers will be connected to a venting system to route the exhaust to the outside of the Albéa building through available existing roof vents.

Fumes generated from welding activities will be captured using fume exhausters of adequate size to capture all fumes generated at the welding site. The fumes will be vented directly outside the Albéa building through available existing roof vents via exhaust piping.

A temperature probe will be used to periodically measure the temperature in the exhaust piping in the building. In addition, thermometers may be placed to measure working area temperatures. A hand-held 10.6 electron volt (eV) PID [MiniRae 3000 or similar) will be used to screen indoor air vapors in the work area and in the vicinity of the drilling operations in accordance with the site health and safety plan.

8.4 Noise and Dust Controls

Noise and dust controls will be implemented during the construction of the ISTR system. Drilling, concrete cutting, and other high noise activities will be limited to the second shift period in order to minimize disruptions to routine day-to-day facility operations. A temporary noise barrier will be installed along the northwestern portion of the Former Molding Room where no partition is present at this location. The noise barrier will be constructed using metal studs and gypsum wall board on each side with therma-fiber insulation. Noise from construction equipment, vehicles, and activities associated with exterior site operations will be monitored using a sound level meter in accordance with Section 01 57 19 of the Technical Specifications.

Daily cleaning protocols will be implemented as needed. Dust controls will be implemented when drilling temperature monitoring point T-14, VMP-4, VMP-5, and the vertical treatment volume verification soil borings inside the Main Production Area. Drilling at this location will use a plastic sheeting (Visqueen™) dust control enclosure around the drilling rig.

8.5 Emergency Plan

The on-site emergency coordinator will be the Ramboll Construction Manager and/or Site Safety Officer. The Construction Managers will be responsible for checking that the Contractor has the equipment and plans in place and/or available to implement the activities listed in the Contingency Plan, which is provided in Appendix H. This includes emergency first aid supplies, spill kits, backup generator, backup pumps, and backup PLC battery.

9. PERMITS

9.1 Ramboll Permitting Activities

Ramboll will complete the following activities related to permitting for the OU3 RA: air discharge permitting, discharge to groundwater permit equivalency, and electric power supply permitting.

9.1.1 Air Discharge

A preconstruction permit, certificate to operate, and permit for construction of a new source will be sought by Ramboll for discharge of treated vapors from the ISTR system. An application for modification to the existing PPPI air permit equivalency (PI No. 85714) will be prepared and added to the equivalency as a new source of emissions.

9.1.2 Discharge to Groundwater Permit Equivalency

The addition of treated condensate water to the GWETS will warrant notification to the NJDEP for acceptance and/or authorization to add this discharge to the GWETS's current Discharge to Groundwater (DGW) Permit-by-Rule Equivalency. This request for discharge authorization will be prepared by Ramboll.

9.1.3 Electric Power Supply

Connection of the ISTR system to the 34.5 kV transmission line requires a detailed process of design activities, agreements and coordination between the engineer/owner and utility. Ramboll is working with First Energy to obtain a permit to make this connection and to determine the required interrupting device (e.g., breaker, circuit switcher or fuses) that will be required at the transmission line connection. In addition, the necessary electrical permit will be sought by TRS for a temporary electrical service connection to their site support trailer.

9.2 Contractor Permitting Activities

The Contractor will be responsible for obtaining the NJDEP well construction permits and local construction and building permits associated with the OU3 RA.

9.2.1 NJDEP Well Construction Permits

The application for new heater/vapor extraction wells and temperature monitoring points will be submitted to the NJDEP for approval by a licensed driller employed by TRS, the installation contractor. This will include a variance needed from NJDEP to allow for the use of 6-inch diameter borings to be used for the collocated TCH and VEW well design.

9.2.2 Local Construction and Building Permits

The New Jersey Department of Community Affairs (NJDCA), Washington Borough and the Town of Washington will be notified of the proposed construction of temporary wall, HVAC modifications, the piping/headers/manifolds, cabling, power distribution equipment, site support trailer, and electrical service installation prior to implementing the work. Construction permits will be applied for in accordance with local requirements by TRS and Ramboll.

10. ISTR SYSTEM DECOMMISSIONING

Once it is determined that the RG has been achieved and the draft Performance Verification Report is approved by the USEPA (see Section 11.3), the ISTR system will be shut down and decommissioned. The decommissioning activities will include the abandonment of the TCH wells and thermocouples, removal of process equipment, and site restoration. These activities are to be completed by the Contractor in accordance with Section 01 94 00 of the Technical Specifications and are described further in the following sections.

10.1 TCH Well Abandonment

The TCH wells will be decommissioned by first removing the wellheads, heaters and liners, meter runs, associated electrical cables, and monitoring hardware from each well. The wellhead equipment and heater cans will be decontaminated in accordance with the QAPP (see Section 4.8) prior to being removed from the Site. Once the well equipment has been removed, each TCH well will be abandoned in accordance with NJDEP requirements, using a standard bentonite cement grout to approximately 2 feet beneath the building slab, followed by patching of the floor penetrations with concrete to match the existing thickness. Depending on the size of the concrete

patch work required at each of the TCH well locations (i.e., TCH well cluster trenches), reinforcing of the concrete patch will be conducted as necessary.

10.2 Thermocouple Abandonment

The TMPs will be decommissioned by first removing the thermocouples and any associated instrumentation from each location. The thermocouples will be decontaminated in accordance with the QAPP (see Section 4.8) prior to being removed from the Site. Each TMP borehole will then be abandoned in accordance with NJDEP requirements, using a standard bentonite cement grout to approximately 2 feet beneath the building slab, followed by patching of the floor penetrations with concrete to match the existing thickness.

10.3 Process Equipment Removal

Following USEPA's approval that the RG has been met, the process equipment, electrical service lines, and interconnected piping and hardware will be removed from the Site as part of the ISTR system decommissioning. The vapor extraction and treatment system and liquid treatment equipment components will be disconnected from all electrical and piping connections. All process equipment components and interconnected piping components will be decontaminated as specified in Section 4.8 prior to removal from the Site. An all-terrain forklift will be used to load the skid-mounted process equipment components onto a flatbed trailer for off-site transport and removal from the Site.

10.4 Site Restoration

Following decommissioning, interior and exterior site restoration activities will be performed. Such activities will include the removal of any remaining equipment, tools, excess material, and temporary facilities, inclusive of the site trailers, temporary utilities, and site security fencing and barriers. During this time, any treatment equipment remaining on-site will be decontaminated in preparation for demobilization. All tools, spare parts, extra materials, permanent locks, and keys will be delivered to the construction manager upon demobilization. Additional Site restoration activities will include removal of decontamination areas and contractor staging and support areas.

A final cleaning of the Former Molding Room and exterior support and process equipment areas on the west side of the facility building will be performed as part of site demobilization. Debris and surface dust will be removed, and concrete floors will be swept clean. All trench excavations and borehole locations on the interior of the facility building will be patched with concrete.

All remaining wastes, rubbish, trash, or debris will be removed from the Site and properly disposed of in accordance with applicable laws, ordinances, and regulations. Paved areas will be broom cleaned. Any petrochemical spills, stains, or other foreign deposits will be cleaned.

11. REMEDIAL ACTION REPORTING

This section documents the reporting to be completed as part of the OU3 RA. For each deliverable discussed in this section, an electronic copy and two bound copies will be submitted to USEPA, and an electronic copy will be provided to the NJDEP. In addition, electronic copies of each deliverable will be provided to USEPA's oversight contractor (USACE).

11.1 Soil Treatment Volume Confirmation Sampling Results

Results from analysis of soil samples from boreholes to the north (north of PDI-SB33) and south (south of PDI-SB32) of the identified impact area will be available after the standard (non-

expedited) laboratory turn around period (7 to 10 business days). These boring locations are shown on Figure D-3 of the Field Sampling Plan in Appendix D. When available, the reported TCE concentrations in the soils from 75 to 120 feet below floor surface in a boring will be tabulated and reported to the USEPA project manager and the USACE support group via email. A boring location map and the preliminary laboratory report (prior to validation) will be presented also. A project status conference call to discuss the results will be scheduled if requested by the USEPA. After completion of the soil borings, a summary table of the borings and boring logs will be provided. As appropriate, the EVS model will be updated with the new soil sample results to re-evaluate the EVS-modeled edge of the TCE impact zones.

11.2 Monthly System Operations Reporting

Systems operations will be evaluated and reviewed weekly and any recommendations deemed necessary to improve the effectiveness of the remedial system (i.e., modifications to the energy input balance, adjustment in vapor extraction system flow rates, and process treatment system modifications) will be communicated to the USEPA in conference calls as necessary. The information gathered from the above tasks for evaluating remedial progress and system performance will be documented in monthly O&M reports and submitted to the USEPA. The effectiveness of the ISTR system in achieving the design objectives will also be reviewed and summarized in the monthly O&M reports.

In general, the monthly O&M reports will include the following:

- brief descriptions of maintenance activities and/or adjustments to the system;
- results from vapor samples collected during the period of operation;
- systems operational data including average TTZ temperatures, simplified energy balance, estimates of TCE mass removed to date, volume of condensate generated/discharged, and performance of the process effluent treatment systems;
- performance of the vapor intrusion mitigation system; and
- results from the indoor air quality (VaporSafe™) monitoring system.

The monthly O&M reports will be submitted following receipt and validation of vapor samples submitted for laboratory analysis during the operational reporting period. Notice of the intent to shut down the ISTR system will be communicated to the USEPA in advance and will be based on the multiple lines of evidence approach described in further detail in Section 11.3.

11.3 Performance Verification Report

Following successful demonstration that the multiple lines of evidence data indicate that *de minimis* concentrations of TCE in subsurface soils have been reached, a petition to shut the system down will be presented to the USEPA in a draft Performance Verification Report and submitted to USEPA for approval. The report will document the results of the ISTR system monitoring and multiple lines of evidence that support demonstration of achievement of the RG. Based on these results, a recommendation will be made in the report on whether post ISTR soil confirmation sampling is necessary to further demonstrate that the ROD remedial goals have been achieved. Advanced notification of the intent to submit the draft Performance Verification Report will be provided, to the extent possible, to ensure timely review and approval by USEPA.

After the USEPA approves the draft Performance Verification Report, the TCH heater wells will be turned off and the extraction and process treatment systems will continue to operate to extract and treat vapors to allow for partial cool down and to capture steam and vapors still present in the

subsurface. During this cool down phase, subsurface temperature and pressure monitoring will continue. This cool down phase is expected to last approximately 21 days and if necessary, post ISTR soil confirmation sampling would be initiated during this period.

11.4 Remedial Action Report

Pursuant to Section XII.B.1 of the OU3 SOW, a draft RA Report will be prepared and submitted to the USEPA for review and approval. The draft RA Report will provide a summary of the work performed during the thermal treatment system installation and operation and will also include results from the one round of post-remediation groundwater and indoor air monitoring discussed in the OM&M Plan. The draft RA Report will be submitted within 60 days of validation of the post-remediation groundwater and indoor air sampling analytical results. The draft RA Report will include a certification statement, signed by a responsible corporate official of Ramboll, which states the following:

> *"To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

12. SCHEDULE

A detailed time schedule for RA activities for OU3 is provided as Figure 8. The schedule incorporates the major tasks presented in this RAWP.

13. REFERENCES

Ramboll Environ. 2017. Final Groundwater Extraction and Treatment System Operation, Maintenance, and Monitoring Plan; Operable Unit (OU) 1 – TCE Groundwater; Pohatcong Valley Groundwater Contamination Superfund Site; Warren County, New Jersey. March.

Ramboll US Corporation. 2018a. Quality Assurance Project Plan (Revision 9), OU1 (TCE Groundwater), OU2, OU3, and Vapor Intrusion Removal Action, Pohatcong Valley Groundwater Contamination Superfund Site, Warren County, New Jersey. February.

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Ramboll US Corporation. 2019. Final (100%) Remedial Design Report. OU3 – TCE Groundwater Contamination Superfund Site, Warren County, New Jersey. April.

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USEPA. 2016b. Record of Decision, Pohatcong Valley Groundwater Contamination Superfund Site Operable Unit 3, Washington Borough and Washington Township, Warren County, New Jersey. September.

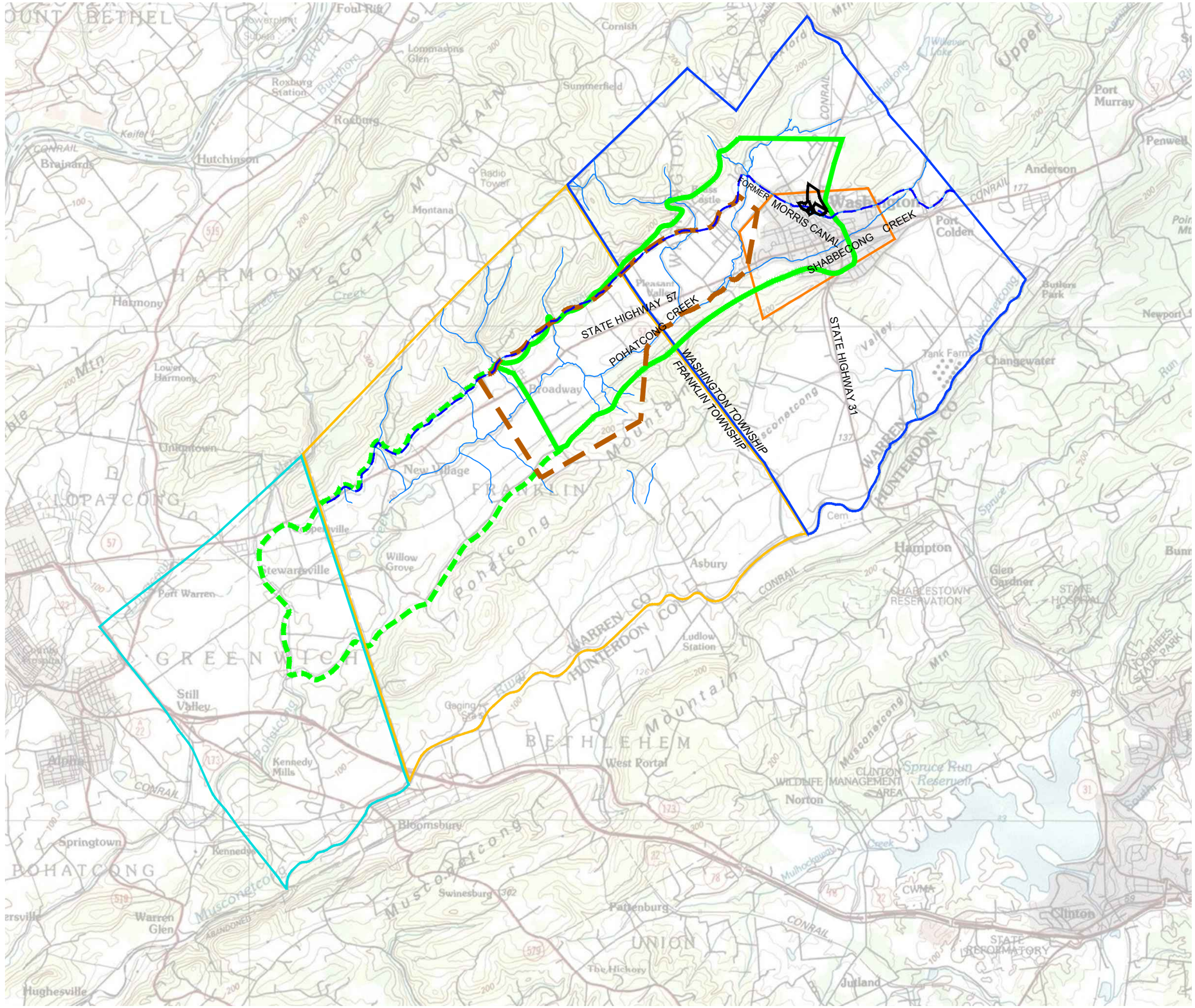
USEPA. 2017. Statement of Work for Implementation of the Operable Unit 3 (OU3) Remedial Design and Remedial Action, pursuant to the Consent Decree entered in United States v. Pechiney Plastic Packaging, Inc., (PPPI), 09-cv-5692 and United States v. Bristol-Myers Squibb Co., et al., 13-cv- 5798. June.

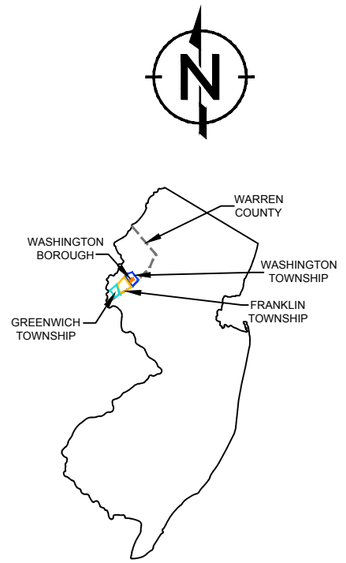
TABLE

Table 1. TCH Well Installation Drilling Sequence
Pohatcong Valley Groundwater Contamination Superfund Site
Operable Unit (OU) 3
Warren County, New Jersey

Activity Name
Drill Rig 1 GSE TSI150 (unmodified 10 foot stroke)
Drilling Mobilization and Setup
Rig 1 Drill Heater Fan 12 (4-7)
Rig 1 Drill Heater Fan 11 (6-8)
Rig 1 Drill Heater Fan 13
Rig 1 Drill Heater Fan 14
Rig 1 Drill Heater Fan 15
Rig 2 Drill Heater Fan 3 (6-7)
Rig 2 Drill Heater Fan 2 (6-7)
Rig 2 Drill Heater Fan 1 (6)
Drill Rig 2 GSE TSI150 (unmodified 10 foot stroke)
Drilling Mobilization and Setup
Rig 2 Drill Heater Fan 9 (6-9)
Rig 2 Drill Heater Fan 10 (6-8)
Rig 2 Drill Heater Fan 8 (6-9)
Rig 2 Drill Heater Fan 7 (6-9)
Rig 2 Drill Heater Fan 6 (6-8)
Rig 2 Drill Heater Fan 5 (6-7)
Rig 2 Drill Heater Fan 4 (6-7)
Drill Rig 3 Parrot Wolf Boart Longyear short mast (5 foot stroke)
Drilling Mobilization and Setup
Drill Heater Fan 7 (1-5)
Drill Heater Fan 8 (1-5)
Drill Heater Fan 9 (1-5)
Drill Heater Fan 6 (1-5)
Drill Heater Fan 5 (1-5)
Drill Heater Fan 4 (1-5)
Drill Heaters - H-36,37,45,44,43,42,41,40,39 & Temp Monitor T-4
Drill Heaters - H-50,51,52,53,54,55,56 & Temp Monitor T-8
Drill Rig 4 Summit Boart Longyear short mast
Drilling Mobilization and Setup
Temp Monitor T-14
SB North - PDI-SB34
SB South - PDI-SB35
Rig 3 Drill Heater Fan 10 (1-5)
Rig 3 Drill Heater Fan 11 (1-5)
Rig 3 Drill Heater Fan 12 (1-3)
Rig 3 Drill Heater Fan 3 (1-5)
Rig 3 Drill Heater Fan 2 (1-5)
Rig 3 Drill Heater Fan 1 (1-5)
Rig 3 Drill Heaters - H-9,8,7,5,6,4,3 & Temp Monitor T-2
Rig 3 Drill Heaters - H-2,1,11,10,12,13,14,15 & Temp Monitor T-1
Rig 3 Drill Heaters - H-16,17,18,19,20,21,38
Drill Rig 5 - TBD Short Mast Rig (mobilized after two tall tower rigs demobilize)
Drilling Mobilization and Setup
Drill Heaters - H-57,70,58,69,59,68,60,67,61,66 & Temp Monitor T12
Drill Heaters - H-62,65,63,71,64
Drill Heaters - H-49,46,47,48,22,23,24,25,26
Drill Heaters - H-27,28,29,30,31,32,33,34,35 & Temp Monitor T-5

FIGURES





LEGEND

- NJDEP WELL RESTRICTION AREA (WRA)
- OU3 BOUNDARY
- USEPA POHATCONG OU1 STUDY AREA
- APPROXIMATE USEPA POHATCONG OU2 STUDY AREA
- FORMER MORRIS CANAL
- WATERWAYS
- GREENWICH TOWNSHIP
- FRANKLIN TOWNSHIP
- WASHINGTON BOROUGH
- WASHINGTON TOWNSHIP

SOURCES:
"FIG 1, LOCATION OF OU1/OU2 STUDY AREAS" CH2MHILL, OU2 REMEDIAL INVESTIGATION. USGS 100K MAP SERIES FROM TOPO!

0 6,500
SCALE IN FEET

LOCATION OF POHATCONG VALLEY GROUNDWATER CONTAMINATION SITE

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL

FIGURE 1

DRAFTED BY: ELS	DATE: 2/13/19	1690008019

L:\Loop Project Files_CAD\1690008019-005_RT_WBS A3.B2.80 33 2413_OU3 MW12\90% RD Rpt\01_Pohatcong Valley GCS Site.dwg

WARREN LUMBER YARD (WLY)

VIKON TILE CORP (VTC)

AREA OF CONCERN (AC1)

AMERICAN NATIONAL CAN (ANC)

ALBÉA WASHINGTON FACILITY

(FORMER PECHINEY PLASTICS PACKAGING, INC.)

SOUCE AREA A

APPROXIMATE LOCATION OF VIRA SVE BLOWER SHED

OU1 (TCE) GROUNDWATER EXTRACTION AND TREATMENT SYSTEM BUILDING (50' x 50')

NORFOLK SOUTHERN (ERIE LACKAWANNA) RAIL ROAD COMPANY SYSTEMS

PAUL SERELIS CORP.

STATE HIGHWAY ROUTE 31 NEW JERSEY

POHMW19 PVWLY07 POHPT2 PVVTC15 POHPT1 POHMW18 POHPT3 PVVTC13 POHMW51 PVVTC14 PVANC32 PVANC39 POHMW25 PVAC105 POHMW49 POHMW50 POHMW10 PVWLY12 PVWLY08 PVWLY09 POHMW11 POHMW6 POHMW8 PVANC01 PVANC02 POHMW3 POHMW4 POHMW14 POHMW15 POHPW6 POHMW13 POHMW12R POHMW9 POHMW1 POHIW1 POHIW2 POHMW5 POHIW3 POHIW4 POHMW7 POHMW2 PVVAN01 PVVAN02

GWE GWI OH

LEGEND

- OU3 PSA BOUNDARIES
- EXISTING FENCE LINE
- EXISTING TREE LINE
- GWI — UNDERGROUND GROUNDWATER INFLUENT PIPE
- GWE — UNDERGROUND GROUNDWATER EFFLUENT PIPE
- MONITORING WELL
- INJECTION WELL
- ALBÉA RECLAMATION WELL
- ALBÉA PRODUCTION WELL
- EXTRACTION WELL
- ABANDONED WELL
- SOURCE AREA A

0 150

SCALE IN FEET

LOCATION OF OPERABLE UNIT 3

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

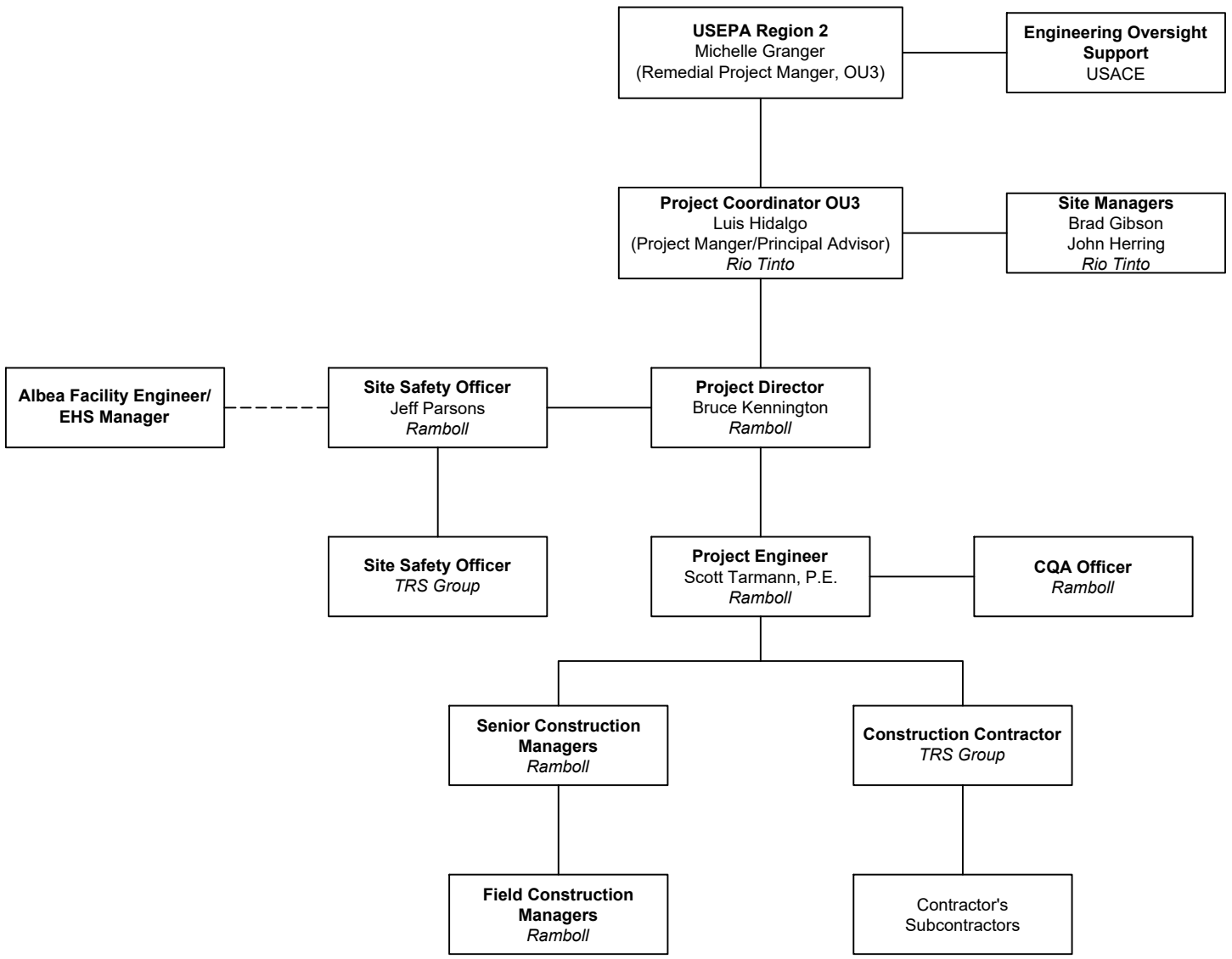
RAMBOLL

FIGURE 2

DRAFTED BY: ELS/CKL | DATE: 7/11/19 | 1690008019

L:\Loop Project Files_CAD\1690008019_RT_WBS_010\OU3 RA Workplan\D-2_Location of Operable Unit 3.dwg

L:\Loop Project Files_CAD\1690008019_RT_WBS_010\OU3 RA Workplan\03_Project Organization OU3 (B-1).dwg



RAMBOLL

DRAFTED BY: ELS/CKL | DATE: 11/27/19

PROJECT ORGANIZATION CHART

OPERABLE UNIT 3
POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
WARREN COUNTY, NEW JERSEY

FIGURE
3

1690008019

WARREN LUMBER YARD
(WYL)

VIKON TILE CORP.
(VTC)

AREA OF CONCERN
(AC1)

SEE STORAGE AREA DETAIL

WATER STORAGE
LGAC VESSELS
BLOWER
VAPOR VESSELS, CONDENSER
VAPOR MITIGATION SHED
PCU 1100-1 & PCU 1100-2
TRANSFORMERS 1 & 2
ELECTRICAL METERING YARD
CONTRACTOR TRAILER, TOOL STORAGE AREA
CONDENSATE STORAGE AREA (POLY TANK)
ADDITIONAL CONTRACTOR MATERIAL STORAGE AREA ALONG FENCE
(STAGING AREA #2)

OU1 (TCE) GROUNDWATER EXTRACTION AND TREATMENT SYSTEM BUILDING

SOURCE AREA A
(FORMER MOLDING ROOM)

AMERICAN NATIONAL CAN (ANC)

ALBEA WASHINGTON FACILITY

MANUFACTURING PRODUCTION AREA

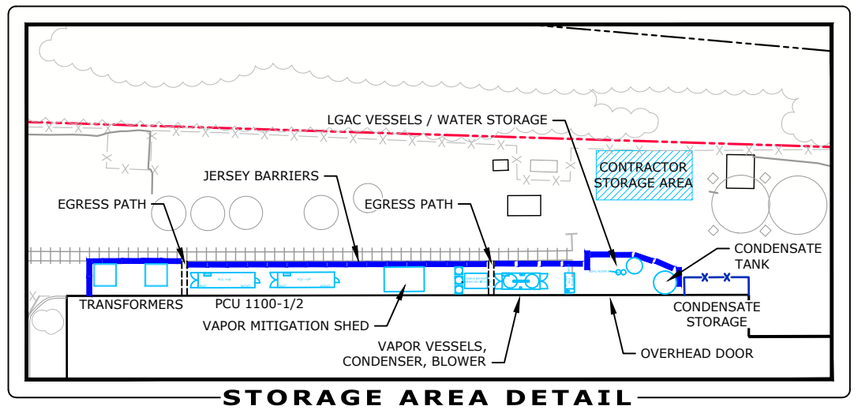
CONTRACTOR MATERIAL LAYDOWN/STORAGE AREA
(STAGING AREA #1)

RAMBOLL SUPPORT TRAILER

STAGING AREA #3

LEGEND

- OU3 BOUNDARY (APPROXIMATE)
- RAMBOLL TRAILER AND SECONDARY CONTRACTOR STAGING AREA (STAGING AREA #3)
- EXISTING FENCE LINE
- TEMPORARY FENCE
- JERSEY BARRIER
- OVERHEAD LINES
- EXISTING TREE LINE
- UNDERGROUND GROUNDWATER INFLUENT PIPE
- UNDERGROUND GROUNDWATER EFFLUENT PIPE



STORAGE AREA DETAIL

SOURCE: AERIAL IMAGERY: GOOGLE EARTH™, IMAGE DATED xx/xx/201x.

0 150
SCALE IN FEET

LOCATION OF CONTRACTOR WORK AREAS

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

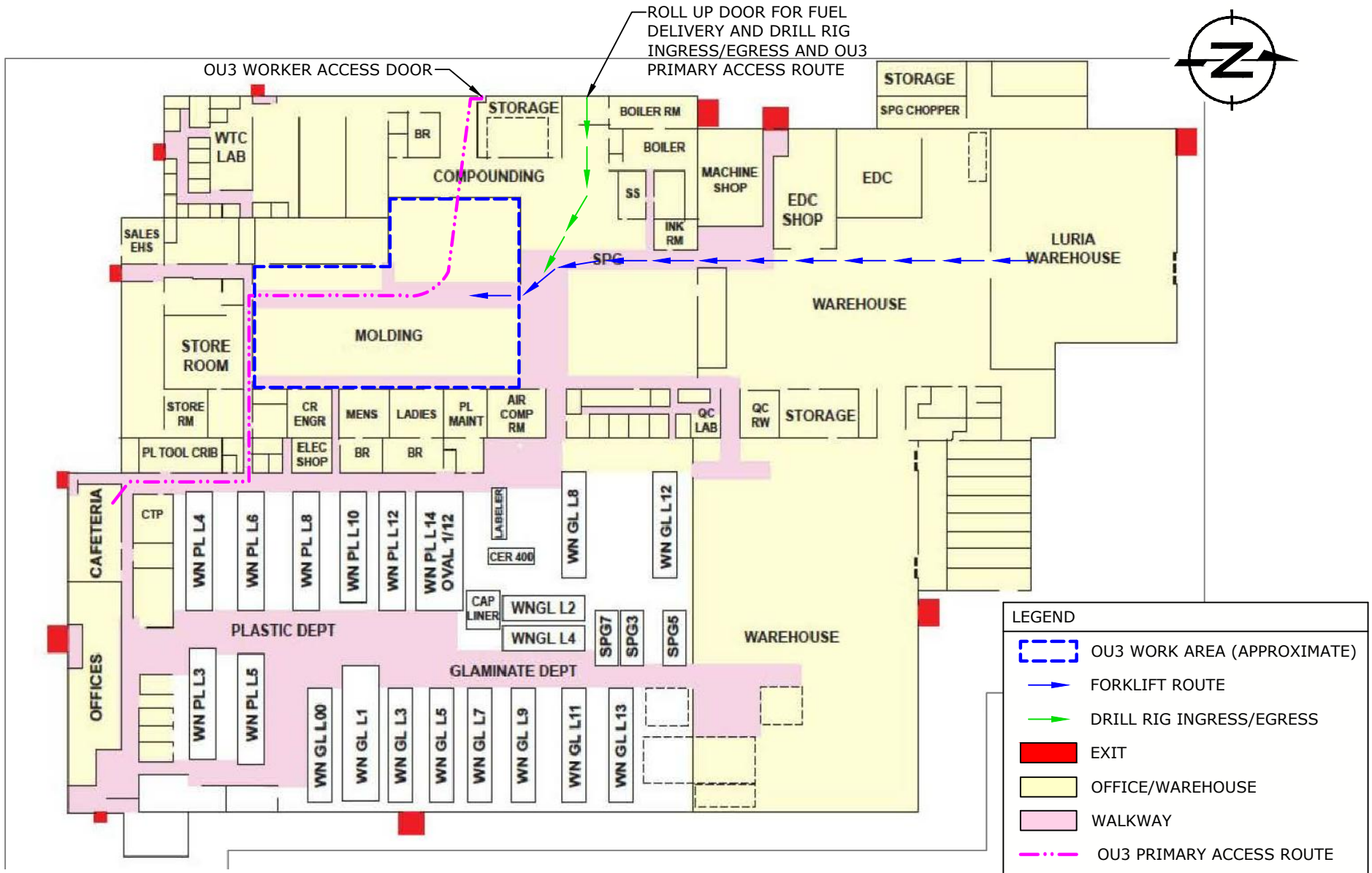
RAMBOLL

FIGURE 4

DRAFTED BY: ELS/CKL | DATE: 12/3/19 | 1690008019

L:\Loop Project Files_CAD\1690014983_ISTR System Design Mods-Updates to RAWP_003\04_Location of Contractor Work Areas.dwg

L:\Loop Project Files_CAD\1690007063_RT_2018 OU3 Remediation Activities_Acad\02_Interior Access Route-OU3 Work Area.dwg



Site map from Albea Washington Plant - Contractor Saftey Package Rev 18 (September 7, 2017).

RAMBOLL

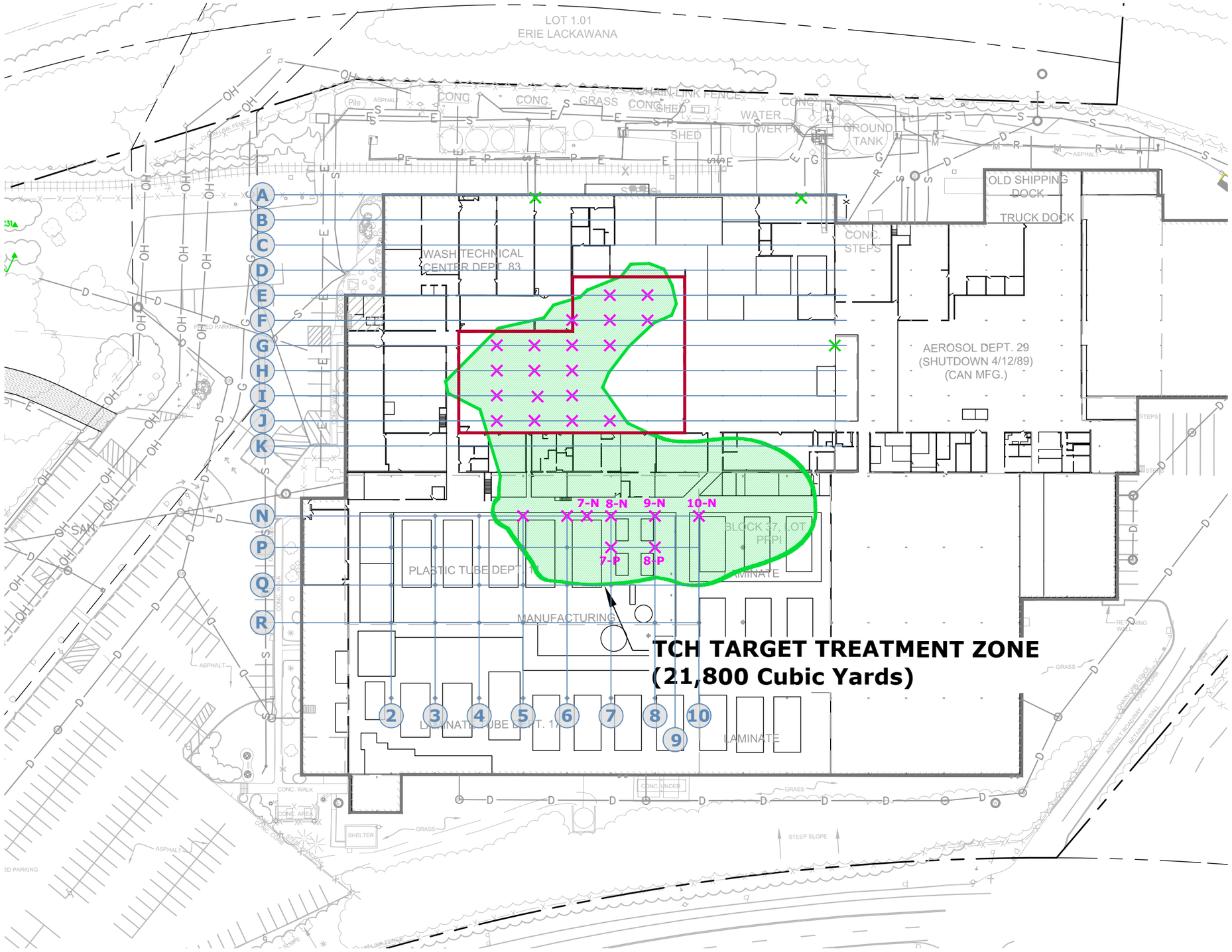
INTERIOR ACCESS ROUTE - OU3 WORK AREA

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE (ALBEA FACILITY)
WARREN COUNTY, NEW JERSEY

FIGURE
5

DRAFTED BY: ELS/CKL | DATE: 2/26/18

1690008019



LEGEND:

- BUILDING COLUMN
- FORMER MOLDING ROOM
- EXTENT OF TCE SOIL IMPACT (CONFIRMED VOLUME)
- E — ELECTRIC LINE
- G — GAS LINE
- S — WATER LINE
- D — STORM LINE
- CONTROL POINT IN TCH ZONE
- CONTROL POINT OUTSIDE TCH ZONE

0 80
SCALE IN FEET

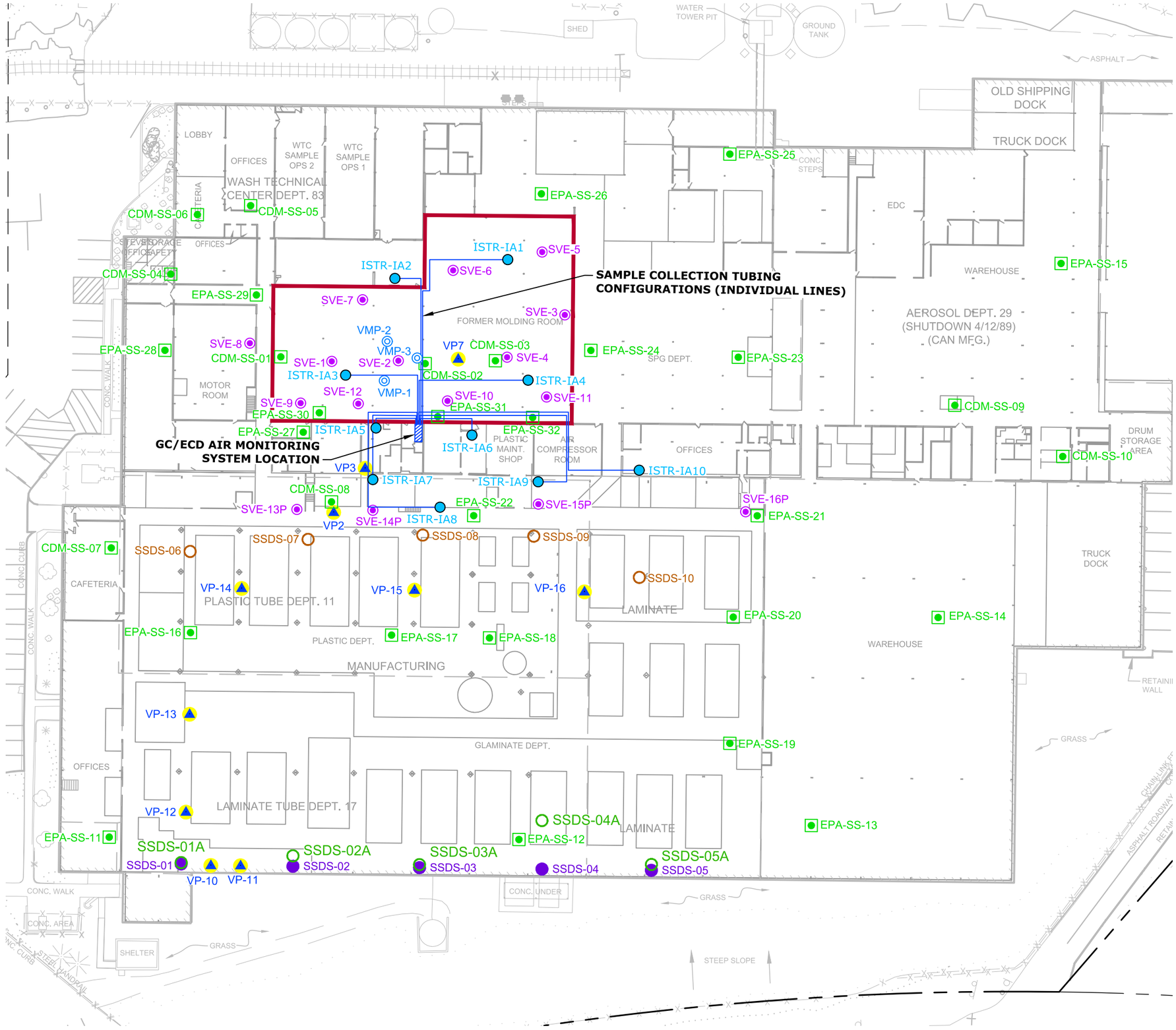
SETTLEMENT MONITORING BENCHMARKS
POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL

FIGURE
6

DRAFTED BY: ELS | DATE: 12/3/19 | 1690008019

L:\Loop Project Files_CAD\1690014983_ISTR System Design Mods-Updates to RAWP_003\06_Settlement Monitoring BMs.dwg



L:\Loop Project Files_CAD\1690014983_ISTR System Design Mods-Updates to RAWP_003\07_Indoor Air Monitoring Locations During ISTR.dwg

LEGEND

- SOURCE AREA
- EPA-SS SUB SLAB VAPOR MONITORING POINT (INSTALLED BY OTHERS)
- VP SUB SLAB VAPOR MONITORING POINT (INSTALLED BY ENVIRON)
- SVE SVE/SSDS EXTRACTION POINT
- SSDS WEST WALL SUB SLAB DEPRESSURIZATION EXTRACTION POINT (STANDBY SSDS POINT)
- SSDS EAST WALL SUB SLAB DEPRESSURIZATION EXTRACTION POINT
- ISTR PROPOSED INDOOR AIR MONITORING LOCATION DURING ISTR OPERATION WITH GC/ECD SYSTEM
- VAPOR MONITORING PROBE

0 60
SCALE IN FEET

INDOOR AIR MONITORING LOCATIONS DURING ISTR

POHATCONG VALLEY GROUNDWATER CONTAMINATION SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

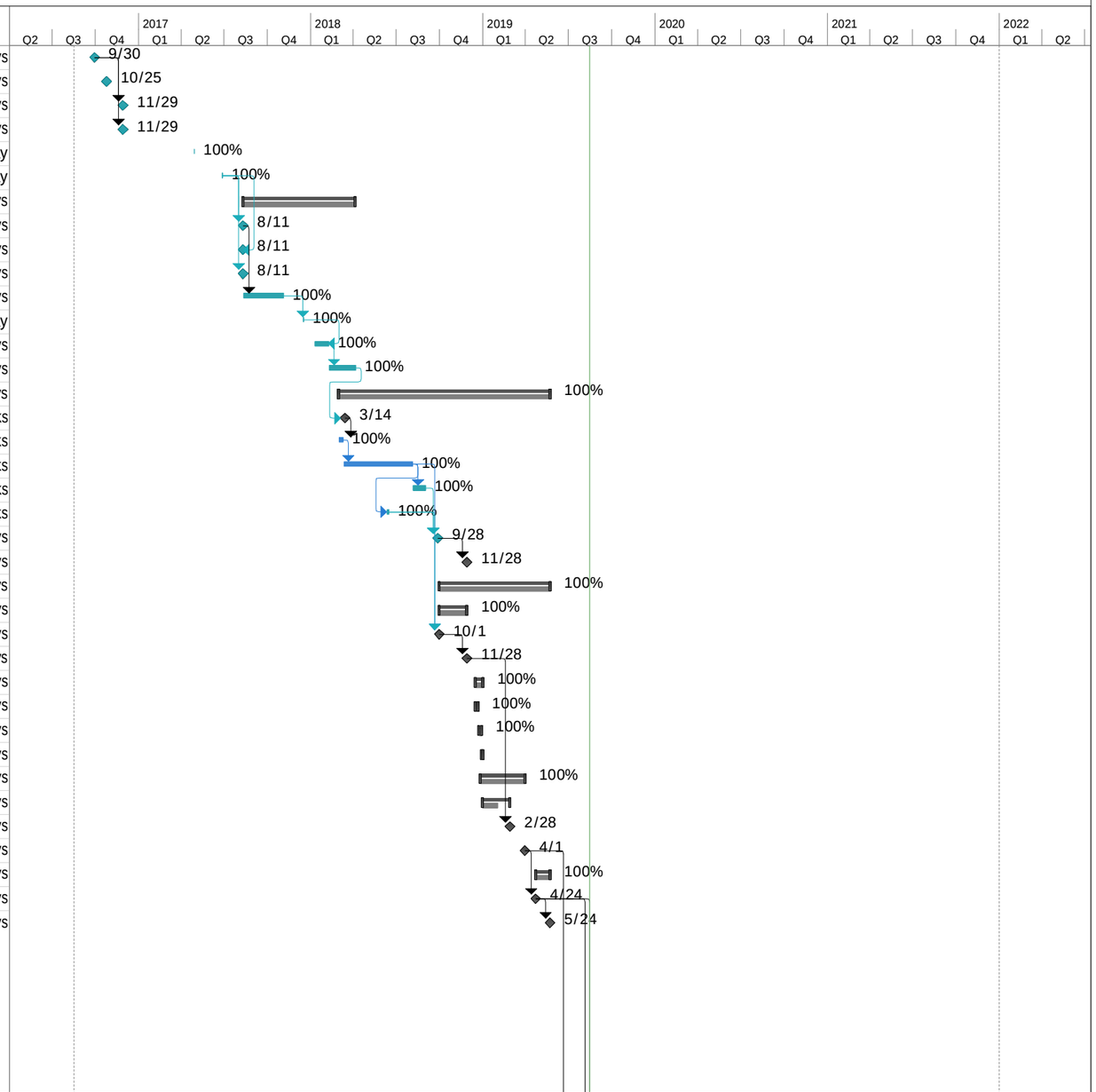
RAMBOLL

FIGURE 7

DRAFTED BY: ELS | DATE: 12/3/19 | 1690008019

FIGURE 8. RD/RA Time Schedule
Remedial Action Work Plan, Operable Unit 3,
Pohatcong Valley Groundwater Contamination
Superfund Site, Warren County, New Jersey

ID	Task Name	Start	Finish	Duration
1	USEPA Issues OU3 ROD	Fri 9/30/16	Fri 9/30/16	0 days
2	PPPI Notice of Project Coordinator & Alt Project Coordinator (SOW III.B)	Tue 10/25/16	Tue 10/25/16	0 days
3	PPPI Notice of Supervising Contractor for OU3 (SOW III.A)	Tue 11/29/16	Tue 11/29/16	0 days
4	PPPI Performance Guarantee for OU3 Work	Tue 11/29/16	Tue 11/29/16	0 days
5	PPPI submittal of Draft OU3 Statement of Work (SOW)	Fri 4/28/17	Fri 4/28/17	1 day
6	USEPA Approval of Draft OU3 SOW	Mon 6/26/17	Mon 6/26/17	1 day
7	Remedial Design Work Plan (RDWP)	Thu 8/10/17	Thu 4/5/18	165 days
8	Submit Draft RDWP to USEPA (SOW VI)	Fri 8/11/17	Fri 8/11/17	0 days
9	Submit Health and Safety Plan (HSP) to USEPA (SOW VII.A)	Fri 8/11/17	Fri 8/11/17	0 days
10	Submit Quality Assurance Project Plan (QAPP) to USEPA (SOW VI.F)	Fri 8/11/17	Fri 8/11/17	0 days
11	USEPA Review & Comment on Draft RDWP (Estimated)	Thu 8/10/17	Thu 11/2/17	84 edays
12	Submit Revised Draft RDWP to USEPA	Fri 12/15/17	Fri 12/15/17	1 day
13	USEPA Approval of Revised Draft RDWP	Mon 1/8/18	Tue 2/6/18	29 edays
14	Submit Final RDWP to USEPA	Fri 2/9/18	Thu 4/5/18	40 days
15	Pre-Design Investigation (PDI)	Thu 3/1/18	Fri 5/24/19	323 days
16	Owner Settling Defendant Clearance of Large Equipment for PDI	Wed 3/14/18	Wed 3/14/18	0 wks
17	PPPI Mobilization for PDI Activities	Thu 3/1/18	Fri 3/9/18	1.4 wks
18	Implement Pre-Design Investigation	Mon 3/12/18	Fri 8/3/18	21 wks
19	PDI Laboratory Analysis & Data Validation	Mon 8/6/18	Fri 8/31/18	4 wks
20	Implement the Pilot/Treatability Study Work Plan (P/TSWP) (SOW VI.D)	Mon 6/11/18	Thu 6/14/18	0.8 wks
21	Submit Draft Pilot/Treatability Study Evaluation (P/TSE) Report to USEPA (SOW VI.D.3)	Fri 9/28/18	Fri 9/28/18	0 edays
22	USEPA Review & Comment on Draft PTSE Report (Estimated)	Sun 10/28/18	Wed 11/28/18	31 edays
23	Remedial Design	Mon 10/1/18	Fri 5/24/19	171 days
24	Preliminary 30% Design	Mon 10/1/18	Wed 11/28/18	43 days
25	Submit Preliminary 30% Design Report to USEPA (SOW IX.A)	Mon 10/1/18	Mon 10/1/18	0 days
26	USEPA Review & Comment on 30% Design	Mon 10/1/18	Wed 11/28/18	58.38 edays
27	Supplemental Soil Borings in MPA (Vertical)	Mon 12/17/18	Tue 1/1/19	14 days
28	Predrilling Activities	Mon 12/17/18	Fri 12/21/18	5 days
34	Drilling Activities	Mon 12/24/18	Sat 12/29/18	6 days
53	Post Drilling activities	Sun 12/30/18	Tue 1/1/19	3 days
60	Pre-Final 90% Design	Thu 12/27/18	Mon 4/1/19	69 days
61	Data Assessment, Modeling Update and Design Changes	Tue 1/1/19	Wed 2/27/19	42 days
68	Submit Pre-Final 90% Design to USEPA	Thu 2/28/19	Thu 2/28/19	0 days
69	USEPA Review of 90% Design & Approval of Design Report	Thu 2/28/19	Mon 4/1/19	32 edays
70	Final 100% Design	Wed 4/24/19	Fri 5/24/19	22 days
71	Submit Final 100% Design to USEPA (SOW X.B)	Wed 4/24/19	Wed 4/24/19	0 days
72	USEPA Approval of 100% Design Report	Fri 5/24/19	Fri 5/24/19	0 days



Baseline Milestone | Critical Progress | Manual Task | Baseline Split | Manual Summary | Inactive Task | Slippage
Baseline Summary | Task | Start-only | Milestone | Project Summary | Inactive Milestone | Baseline
Critical | Split | Finish-only | Summary Progress | External Tasks | Inactive Summary
Critical Split | Task Progress | Duration-only | Summary | External Milestone | Deadline

Date: 8/16//2019
Version: 0

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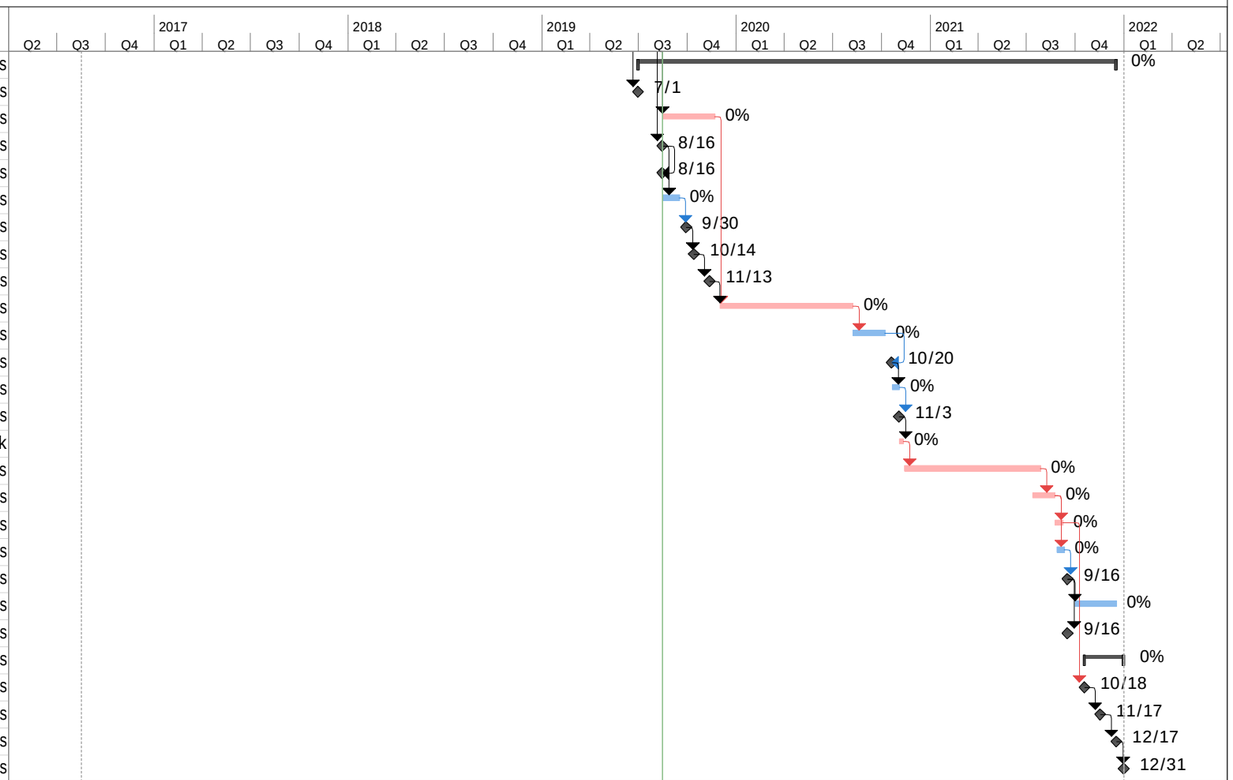
FIGURE 8. RD/RA Time Schedule
Remedial Action Work Plan, Operable Unit 3,
Pohatcong Valley Groundwater Contamination
Superfund Site, Warren County, New Jersey

ID	Task Name	Start	Finish	Duration
73	Remedial Action (RA) - ISTR	Mon 7/1/19	Thu 12/16/21	644 days
74	Award of Contract to Construction Contractor (SOW XI)	Mon 7/1/19	Mon 7/1/19	0 days
75	Equipment Procurement	Fri 8/16/19	Thu 11/21/19	14 wks
76	Submit Remedial Action Work Plan (RAWP) to USEPA (SOW XI.A)	Fri 8/16/19	Fri 8/16/19	0 days
77	Submit HSP for Remedial Action to USEPA	Fri 8/16/19	Fri 8/16/19	0 days
78	USEPA Review & Comment on RAWP	Fri 8/16/19	Mon 9/16/19	31 edays
79	Submit Final RA Work Plan to USEPA	Mon 9/30/19	Mon 9/30/19	0 days
80	USEPA Approval of RAWP	Mon 10/14/19	Mon 10/14/19	0 days
81	Mobilize to Initiate Remedial Action (SOW XI.C.1)	Wed 11/13/19	Wed 11/13/19	0 wks
82	Remedial Construction - Drilling & Process Equipment	Mon 12/2/19	Fri 8/7/20	9 mons
83	Remedial Construction - TCH Installation	Fri 8/7/20	Tue 10/6/20	60 edays
84	Pre-Final Inspection with USEPA (SOW XII.A.1)	Tue 10/20/20	Tue 10/20/20	0 days
85	Punch List Corrective Actions (Assumed)	Tue 10/20/20	Tue 11/3/20	2 ewks
86	Follow-on Inspection with USEPA (if needed)	Tue 11/3/20	Tue 11/3/20	0 days
87	RA Shakedown Testing & Startup	Wed 11/4/20	Tue 11/10/20	1 wk
88	RA OM&M	Thu 11/12/20	Mon 7/26/21	256 edays
89	Confirmation Sampling	Mon 7/12/21	Mon 8/23/21	6 ewks
90	Laboratory Analysis & Data Validation	Mon 8/23/21	Mon 9/6/21	2 ewks
91	Performance Verification Reporting	Thu 8/26/21	Thu 9/9/21	2 ewks
92	USEPA Approval of Shutdown	Thu 9/16/21	Thu 9/16/21	0 days
93	RA Decommissioning & Abandonment	Fri 10/1/21	Thu 12/16/21	11 wks
94	Commence Long-term Monitoring	Thu 9/16/21	Thu 9/16/21	0 days
95	Remedial Action (RA) Report	Mon 10/18/21	Fri 12/31/21	54 days
96	Submit Draft RA Report to USEPA (SOW XI.B.1)	Mon 10/18/21	Mon 10/18/21	0 days
97	USEPA Review & Comment on Draft RA Report	Mon 10/18/21	Wed 11/17/21	30 edays
98	Submit Final RA Report to USEPA	Fri 12/17/21	Fri 12/17/21	0 days
99	USEPA Approval of Final RA Report	Fri 12/31/21	Fri 12/31/21	0 days



Date: 8/16//2019
Version: 0

Baseline Milestone
Baseline Summary
Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Manual Task
Start-only
Finish-only
Duration-only
Baseline Split
Milestone
Summary Progress
Summary
Manual Summary
Project Summary
External Tasks
External Milestone
Inactive Task
Inactive Milestone
Inactive Summary
Deadline
Slippage
Baseline

RAMBOLL

APPENDIX A

ELECTRICAL CONTRACTOR CERTIFICATIONS

TRS Group, Inc.
Accelerating Value

TRS Group, Inc.
PO Box 737
Longview, WA 98632

www.thermalrs.com

TRS Group, Inc. – Competent/Authorized Person Declaration

Definition

A competent person is a person having the ability to recognize the existing and predictable hazards and having the authority to correct them.

Responsibility

The designated TRS Group, Inc. (TRS) competent person is responsible for recognizing and correcting the safety risks/hazards for the tasks they are assigned to complete. The Competent Person has the authority to stop work when a potential safety concern arises on any project site.

Acknowledgement

I, as an employee-owner of TRS Group, Inc., have been assigned to perform the listed tasks at an *in situ* thermal remediation (ISTR) project site. I have been trained and observed by senior staff personnel to be a Competent Person or Authorized person in the areas indicated below. I acknowledge that the I have been thoroughly trained and am experienced in hazard recognition and have the authority and the responsibility to stop work and correct hazards in the event of a potential hazardous or imminent danger situation.

Kevin Riffe — *TRS Employee-Owner (Printed)*

11-6-19 — *(Date)*

TRS Employee-Owner (Signature)

TRS Supervising Employee-Owner (Printed)

(Date)

TRS Supervising Employee-Owner (Signature)

TRS Competent Person

- X General Safety and Health
- X HAZWOPER
- X First Aid/CPR
- X Fire Protection and Prevention
- X PPE
- X Hazard Communication
- X Air Monitoring
- X Respiratory Protection
- X General Electrical
- X Electrical Equipment Maintenance
- X Lock-Out/Tag-Out
- X Aerial Lifts
- X Fall Protection
- X Cranes/Critical Lifts
- X Signaling
- X Motor Vehicles
- X Forklift/Skid Steer
- X Ladders and stairways
- X TRS CSP
- X Site-Specific HASP
- X General Construction
- X Basic Hand Tools
- X Trenches/Excavations
- X Site Supervisor
- X Concrete Construction

TRS Authorized Person

- X High Voltage Inspection
- X ISTR System Startup
- X ERH Voltage Testing
- X Hot Groundwater Sampling
- X Hot Soil Sampling
- X Steam-Laden Vapor Sampling
- X SERT
- X ISTR Element Fabrication
- X Drilling Oversight

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I, as an employee-owner of TRS Group, Inc., have been assigned to perform the listed tasks at an *in situ* thermal remediation (ISTR) project site. I have been trained and observed by senior staff personnel to be a Competent Person or Authorized person in the areas indicated below. I acknowledge that the I have been thoroughly trained and am experienced in hazard recognition and have the authority and the responsibility to stop work and correct hazards in the event of a potential hazardous or imminent danger situation.

JEFF RIFFE — *TRS Employee-Owner (Printed)*

11/6/19 — *(Date)*

TRS Employee-Owner (Signature)

TRS Supervising Employee-Owner (Printed)

(Date)

TRS Supervising Employee-Owner (Signature)

TRS Competent Person

- ✓ General Safety and Health
- ✓ HAZWOPER
- ✓ First Aid/CPR
- ✓ Fire Protection and Prevention
- ✓ PPE
- ✓ Hazard Communication
- ✓ Air Monitoring
- ✓ Respiratory Protection
- ✓ General Electrical
- ✓ Electrical Equipment Maintenance
- ✓ Lock-Out/Tag-Out
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- ✓ Cranes/Critical Lifts
- ✓ Signaling
- ✓ Motor Vehicles
- ✓ Forklift/Skid Steer
- ✓ Ladders and stairways
- ✓ TRS CSP
- ✓ Site-Specific HASP
- ✓ General Construction
- ✓ Basic Hand Tools
- ✓ Trenches/Excavations
- ✓ Site Supervisor
- ✓ Concrete Construction

TRS Authorized Person

- ✓ High Voltage Inspection
- ✓ ISTR System Startup
- ✓ ERH Voltage Testing
- ✓ Hot Groundwater Sampling
- ✓ Hot Soil Sampling
- ✓ Steam-Laden Vapor Sampling
- ✓ SERT
- ✓ ISTR Element Fabrication
- ✓ Drilling Oversight

APPENDIX B

CONSTRUCTION QUALITY ASSURANCE PLAN

Prepared for:
Pechiney Plastic Packaging, Inc.
South Jordan, Utah

Submitted to:
United States Environmental Protection Agency Region II
New York, New York

Date:
December 2019

Project Number:
1690008019

CONSTRUCTION QUALITY ASSURANCE PLAN

OPERABLE UNIT 3, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE WARREN COUNTY, NEW JERSEY

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333 West Wacker Drive
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Chicago, IL 60606
USA
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www.ramboll.com

RAMBOLL

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FIGURE

Figure B-1: Project Organization Chart

ATTACHMENT

Attachment 1: Construction, System and Equipment Checklists

ACRONYMS AND ABBREVIATIONS

AC1	Area of Concern 1
Albéa	Albéa Americas Inc.
ANC	American National Can
CQA/CQC	construction quality assurance/construction quality control
CQAP	Construction Quality Assurance Plan
HASP	Health and Safety Plan
ISTR	*in-situ* thermal remediation
OM&M	Operations, Maintenance, and Monitoring
OU	Operable Unit
PCE	tetrachloroethene
PDI	Pre-Design Investigation
PPPI	Pechiney Plastic Packaging, Inc.
PVGCS	Pohatcong Valley Groundwater Contamination Superfund
RA	remedial action
Ramboll	Ramboll US Corporation
RD	remedial design
ROD	Record of Decision
SOW	Statement of Work
SVE	soil vapor extraction
TCE	trichloroethylene
TCH	thermal conductive heating
TTZ	Target Treatment Zone
USEPA	United States Environmental Protection Agency
VEW	vapor extraction well
VTC	Vikon Tile Corporation
WLY	Warren Lumber Yard

1. INTRODUCTION

On behalf of Pechiney Plastic Packaging, Inc. (PPPI), Ramboll US Corporation (Ramboll) has prepared this Construction Quality Assurance Plan (CQAP) associated with the site activities to be implemented for construction of an *In-Situ* Thermal Remediation (ISTR) System for treatment of trichloroethene (TCE) in vadose zone soils in Source Area A of Operable Unit 3 (OU3) of the Pohatcong Valley Groundwater Contamination Superfund (PVGCS) Site located within the former American National Can (ANC) building at the facility presently owned and operated by Albéa Americas Inc. (Albéa) and located at 191 Route 31 North in Washington, New Jersey ("Site"). The Site is identified by the United States Environmental Protection Agency (USEPA) as ID# NJD981179047.

1.1 Scope and Objectives

This CQAP is to provide the information needed to coordinate the quality control procedures to be used for the construction of the ISTR System. This CQAP outlines the program to ensure that the ISTR System is installed in conformance with the Final (100%) Design, Remedial Action Addendum No.1, and Remedial Action Addendum No.2 for OU3.

The construction of the ISTR System for OU3 will include drilling for installation of heater/vapor extraction wells and temperature monitoring points, installation of piping, vapor treatment and liquid treatment systems, electrical power supply and control systems for the ISTR heaters, and setup of data acquisition systems for monitoring of the OU3 remedial action.

1.2 Site Background

The PVGCS Site encompasses an area of about 16.5 square miles (10,600 acres) that extends about 8.5 miles along the length of the Pohatcong Valley, which is a northeast-southwest trending valley bounded by mountains. The Site is divided into three operable units. Operable Unit 1 (OU1), which covers about 8.75 square miles extending about 5 miles along the Pohatcong Valley, is defined by the USEPA as the study area established to address TCE and tetrachloroethene (PCE) contaminated groundwater within Washington Borough, and parts of Washington and Franklin Townships. OU2 is defined by the USEPA as the portion of the Site downgradient from OU1 where TCE is present in groundwater. The OU3 Study Area is located in Washington Borough and has been identified by the USEPA as a source of TCE contamination in soils contributing to contamination found within the underlying groundwater aquifer. The OU3 Study Area comprises four properties known as: ANC, Area of Concern 1 (AC1), Vikon Tile Corporation (VTC), and Warren Lumber Yard (WLY) properties.

1.3 Project Description

The current project focuses on remediation of Source Area A, which contains the deep TCE-contaminated soils underlying the southwestern portion of the former ANC building identified as the volume of soils to be treated in the USEPA's Record of Decision (ROD) for OU3.

The remedy selected by the USEPA as presented in the ROD includes the implementation of ISTR to address deep soil contamination from TCE underlying the Albéa Washington Facility building. Based on the results of the Pre-Design Investigation (PDI) soil borings conducted and soil vapor extraction (SVE) pilot testing performed at the Site in 2018, ISTR using a thermal conductive heating (TCH) technology, was recommended for remedial design (RD) and remedial action (RA) of the OU3 soils of Source Area A.

Accordingly, this CQAP pertains to the construction of the ISTR System with TCH technology for OU3 as described in the accompanying Final (100%) Design Report, Remedial Action Addendum No.1, and Remedial Action Addendum No.2. The ISTR System consists of TCH borings, each with co-located vapor extraction wells (VEWs) installed within the zone of treatment (i.e., the Target Treatment Zone [TTZ]). Electric power is supplied to the heaters, heating the surrounding soils through thermal conduction. As a vacuum is drawn on the VEWs, steam and vaporized TCE is conveyed to on-site equipment for treatment of vapors and liquids.

The major components of the ISTR System include:

- TCH heaters with co-located VEWs installed with the TTZ;
- vapor phase extraction and treatment equipment;
- liquid phase treatment equipment;
- electric power supply, transformers, and control equipment; and
- instrumentation and process control equipment.

2. CQA ROLES, RESPONSIBILITIES, AND QUALIFICATION

2.1 CQA Organization

Construction of the ISTR System will be performed in accordance with the Contract Documents, project-specific Health and Safety Plan (HASP), this CQAP, the Final (100%) Design, Remedial Action Addendum No.1, and Remedial Action Addendum No.2 for OU3. The construction quality assurance/construction quality control (CQA/CQC) activities will be performed by qualified personnel. Figure B-1 provides a general Project Organization Chart for OU3.

2.2 Regulatory Authority

Pursuant to the Consent Decree and the OU3 Statement of Work (SOW), USEPA has authority over the OU3 RD/RA activities.

2.3 Respondent

The organization or corporation that assumes overall project management and direction of the thermal treatment activities. PPPI is the Respondent under the Consent Decree for OU3 at the Site.

2.4 Design-Build Contractor

The Project Design-Build Contractor (Ramboll) has been retained by PPPI to provide CQA services during the implementation of the thermal treatment activities, and to document that the activities are conducted in accordance with this CQAP, design drawings, and project specifications.

Project Director - The Project Director will act as liaison between PPPI, PPPI's Project Coordinator, and the USEPA. The Project Director serves as the primary point of contact for the OU3 RD/RA activities and is responsible for the preparation and implementation of this CQAP.

Design/Project Engineer - The Project Engineer will have the ultimate technical responsibility for the work performed. The Project Engineer will also be responsible for overall coordination of CQA/CQC activities. The Project Engineer must be a professional engineer, familiar with the OU3 Design Report, and licensed in the State of New Jersey.

CQA Officer and Observers - The CQA Officer will report to the Project Engineer and will be responsible for coordination of observation, sampling, testing, and documentation of construction activities. The CQA Officer may employ specialists in particular aspects of the installation/operation to provide additional knowledge and experience. CQA observer(s) will be on site on a regular basis to document, collect samples, and conduct field testing under the direction of the CQA Officer. CQA Officer responsibilities include:

- perform and document field and laboratory testing to be performed by the Design-Build Contractor at the frequency established in this CQAP;
- perform and document field sampling for CQA/CQC testing;
- observe and record procedures used for site preparation and remediation activities;
- coordinate samples to be sent to the CQA/CQC laboratory;
- prepare daily reports;
- observe TCH heater well and process treatment equipment installation; and
- observe and record start up and functional testing of process equipment.

Laboratory - The CQA/CQC laboratory(ies) will be an independent testing laboratory to conduct testing, as directed by the CQA Engineer.

2.5 Remediation Contractor

A remediation contractor will be employed by the Design-Build Contractor to construct the ISTR System in accordance with the design drawings and specifications. The remediation contractor will be experienced in the construction of the ISTR System presented in the design. TRS Group, Inc. (TRS) has been chosen as the remediation contractor. A remediation contractor Project Manager, remediation contractor Project Engineer (referred to as Remediation Contractor Project Engineer), Site Supervisor and Lead Operator will be assigned to this project. The Contractor will provide evidence that the Site Supervisor and Lead Operator have had prior experience on similar projects and is familiar with the construction methods required on this project.

The remediation contractor will have the following responsibilities associated with CQA procedures.

- review and be completely familiar with all the Contract Documents including but not limited to the OU3 Design Report and this CQAP;
- maintain a continuous line of communication with the CQA personnel to identify and discuss field issues as they arise;
- coordinate with all equipment suppliers to ensure compliance with the OU3 Design requirements;
- prepare and submit all required submittals to CQA personnel;
- identify potential design and/or construction issues as early as possible to allow resolution in a manner that will not impact the quality of the system installation and the schedule of start-up activities; and
- maintain a continuous record of approved changes or modifications to the design report.

2.6 Required Meetings

2.6.1 Construction Kick-Off Meeting

Prior to the start of construction activities, a construction kick-off meeting will be held among representatives of PPPI, PPPI's Project Coordinator, Project Director, Project Engineer, CQA Officer, and remediation contractor's Project Manager and Site Supervisor. The topics covered at this kick-off meeting will include, but may not be limited to, the following:

- familiarizing each organization with current site conditions, the site-specific CQA/CQC procedures, and this CQAP's role relative to the design criteria, plans, and specific information;
- reviewing the responsibilities of each organization;
- discussing the established procedures and protocols for deficiencies, repairs, and retesting;
- discussing procedures for the location and protection of equipment and materials, and for the prevention of damage of equipment and materials from inclement weather or other adverse conditions; and
- conducting a site walk-through to review site conditions, including work areas and approximate limits of work, as well as staging and storage locations.

The construction kick-off meeting will be documented by the CQA Officer, and a meeting summary will be transmitted to all in attendance.

2.6.2 Progress Meetings

Daily meetings will be attended by the remediation contractor's Site Supervisor, Project Design-Build Contractor's on-site representative, and remediation contractor's construction personnel to discuss day-to-day operations, daily schedule, health and safety matters, coordination of construction activities, and general project status.

Weekly progress meetings will be held with the remediation contractor's Project Manager, Project Design-Build Contractor's Site Supervisor, and Project Engineer during the construction of the ISTR System. PPPI's representative, Project Coordinator for OU3, Project Director, and USEPA may also attend some or all these weekly progress meetings. The weekly progress meetings will be scheduled by the Project Engineer. Weekly progress meetings will be held to discuss issues including, but not limited to, project status, review of CQA observations, management of change, time schedule, scope of work, and overall project implementation.

3. CQA ACTIVITIES

3.1 General

Project monitoring will be performed based on a combination of the review for general compliance with the Final (100%) Design, including Remedial Action Addendum No.1 and Remedial Action Addendum No.2 for OU3, submittal review, periodic project meetings, and on-site observation. The requirements of the Final (100%) Design, Remedial Action Addendum No.1, and Remedial Action Addendum No.2 for OU3 will provide the framework for CQA/CQC procedures. Such activities will involve the review of technical submittals; material/equipment testing, on-site observation, and review of the remediation contractor's start-up activities.

Throughout the construction of the ISTR System, there will be various inspections and testing requirements for specific work tasks. In general, inspections to be conducted by the CQA Officer or CQA observer(s) include the following:

- daily inspection of work in progress;
- inspection of the material as it is delivered to the Site to check for any damage during delivery;
- comparison of the material delivered to the Site with the Final (100%) Design to ensure the proper material has been delivered to the Site;
- inspection of materials after installation to verify that no damage occurred during installation;
- oversight and documentation of the completion of CQA checklists, provided in Attachment 1 to this CQAP;
- Borehole surveying to measure the alignment (direction and inclination) of the angled TCH heater wells;
- an inspection will be performed upon completion of each work task to verify compliance with the Drawings and Specifications of the Final (100%) Design for OU3 and to ensure that deficiencies identified during the inspections have been corrected;
- taking of representative photographs of significant project features and progress during each inspection or test; and
- review of operational and functional testing of components.

Any problems identified are to be corrected and corrective actions added to the checklists prior to the final inspection.

3.2 CQA Inspections/Testing/Commissioning

Site inspections/reviews will be conducted by the Project Engineer and/or CQA personnel prior to and during construction of the ISTR System as noted above and in the Construction System and Equipment Checklists. At the completion of construction at each TCH well group as described in the Remedial Action Work Plan, the CQA Officer or Project Engineer will schedule a pre-final inspection and, upon completion of corrective actions required during the pre-final inspection, a final inspection will be held.

After a successful final inspection, system commissioning is to be conducted by the Contractor. The CQA Officer, Project Engineer, or designated representative will confirm that commissioning of the treatment system equipment occurs with clean air/water takes place before initial start-up of Group A heaters. Some of the commissioning tasks to be observed are included in the Construction, System and Equipment Checklists provided in Attachment 1. In addition, the CQA representative will ensure that the following are completed/operational in accordance with the Design Report:

- alarm and interlock functions;
- alarm notification functions;
- transfer lines have been leak-tested;
- liquid tanks, vessels, heat exchanger, cooling tower are filled to start-up levels;
- carbon beds are flooded and de-aerated;
- HASPs are reviewed by operator(s); and

- sampling and measurements are planned as required in the Operation, Monitoring, and Maintenance (OM&M) Plan.

The CQA representative will verify the documentation during the commissioning phase and confirm that deficiencies noted are repaired/adjusted. Heating of the subsurface will not be allowed at any of the TCH heater groups until the CQA Officer and/or Project Engineer report that the treatment systems are fully functional, balanced, and operating as designed.

3.3 Corrective Measures and Work Deficiency Meetings

Quality issues which arise and require corrective measures will be documented by CQA personnel. The Project Engineer will be promptly notified of identified deficiencies that may require corrective measures. A special meeting may be held with a problem or deficiency developed. A summary of the meeting including a plan for corrective measure to address identified deficiency and follow-up actions will be documented by the CQA Officer. Following implementation of the identified corrective measures, the CQA Officer shall report to Project Engineer on the effectiveness of the corrective actions and document the measures taken for the project record.

4. CQA DOCUMENTATION

4.1 CQA Documentation

The CQA Officer will be responsible to ensure that a daily log documenting the work performed and completed by the remediation contractor is maintained. The CQA Observer(s) will issue to the CQA Officer reports summarizing the CQA activities including, at a minimum, visual observations, test results, problems encountered, and solutions achieved. The CQA Officer will also document completion of the Construction, System and Equipment Checklists as noted in Section 3.

4.2 CQA/CQC Pre-Installation Submittals

The CQA Officer and Project Engineer will prepare a comprehensive list of required submittals and a schedule for submittal/approval. Proposed modifications from the requirements of the OU3 Design Drawings and specifications must be shown and highlighted by the remediation contractor on the submittals. Submitted data will be reviewed by the Project Engineer as follows:

1. "Reviewed" if no objections are observed or no comments made.
2. "Reviewed and Noted" if minor objections, comments, or additions are made but re-submittal is not considered necessary provided the remediation contractor addresses the noted items.
3. "Resubmit" if the objections, comments, or additions are extensive. In this case, the remediation contractor will resubmit the items after revision.
4. "Rejected" if the submittal under consideration is not, even with reasonable revision, acceptable or when the data submitted are not sufficiently complete to establish compliance with the OU3 Design Drawings and Specifications.

4.3 Construction Documentation and Submittals

The remediation contractor shall submit the following documentation within 30 days following construction completion (if not already provided) to the Design-Build Contractor or Engineer:

- record drawings/as-built documents;
- copies of permits/permit submittals;

- copies of inspection reports from local jurisdictions having authority;
- waste material transportation and disposal documents, if applicable;
- copies of field-testing reports; and
- additional documents as requested by the Engineer, PPPI, or USEPA.

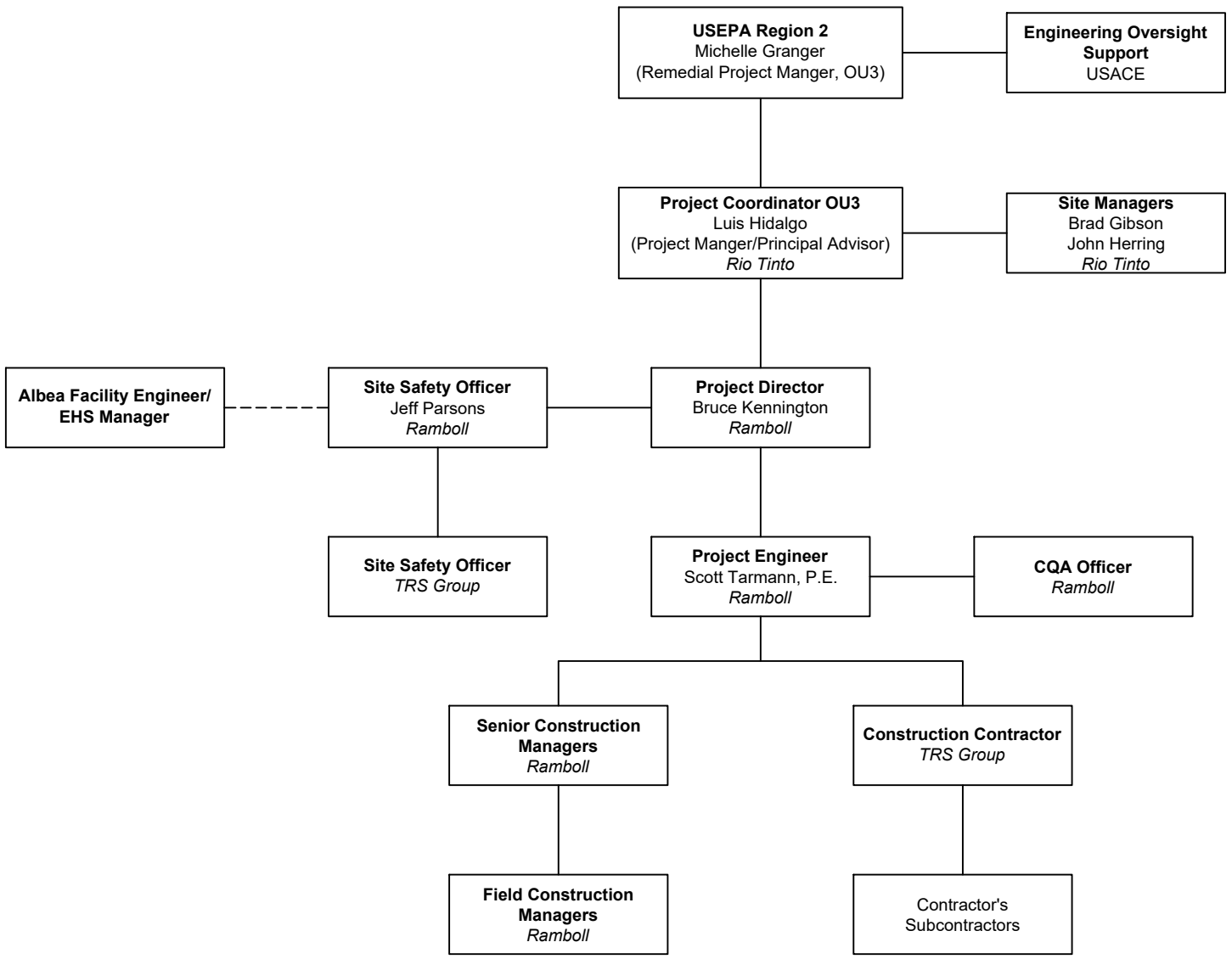
4.4 Remedial Action Report

Pursuant to Section XII.B.1 of the OU3 SOW, a draft RA Report will be prepared and submitted to the USEPA for review and approval. The RA Report will provide a summary of the work performed during the thermal treatment system installation, copies of construction inspection certificates, record drawings/as-built documents, waste disposal documentation, and field-testing reports. The draft RA Report will be submitted within 60 days of validating laboratory analytical data from the one round of post-remediation groundwater and indoor air monitoring as discussed in Section 8.7. of the Final (100%) Remedial Design report. The RA Report shall include a certification statement, signed by a responsible corporate official of Ramboll, which states the following:

> "*To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*"

FIGURE

L:\Loop Project Files_CAD\1690008019_RT_WBS_010\OU3 RA Workplan\03_Project Organization OU3 (B-1).dwg



RAMBOLL

DRAFTED BY: ELS/CKL | DATE: 11/27/19

PROJECT ORGANIZATION CHART

OPERABLE UNIT 3
POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
WARREN COUNTY, NEW JERSEY

FIGURE
B-1

1690008019

ATTACHMENT

CONSTRUCTION, SYSTEM AND EQUIPMENT CHECKLISTS

Thermal

Safety Systems Checklist

Item Description	Problems/Corrective Actions	By	Date
Site-specific training completed			
HASP available in trailer			
Health and safety monitoring complete			
Appropriate PPE stocked			
Lockout/Tagout supplies stocked			
Arc flash kit present			
Belt and/or shaft guards are installed			
Safety Data Sheets (SDS) available in trailer			
Decon station in place and decon materials provided			
Treatment area clear and organized			
Warning signs posted (electrical, flammable, exclusion zone, etc.)			
Barricades/Fencing around any exclusion zones (including signage)			
Fire extinguishers installed and inspection tags current			

Thermal

Safety Systems Checklist

Item Description	Problems/Corrective Actions	By	Date
Electrical cables and wiring covered/protected @ traffic areas			
Evacuation routes posted			
Emergency shutdown procedures posted			
Emergency contacts posted			
Safety Shower(s) and/or Eye Wash Station(s) installed and functional			
First Aid and Spill Kits in place			
Meeting with first responders completed			

Thermal

Wellfield Equipment Checklist

Item Description	Problems/Corrective Actions	By	Date
Inspect for damaged components			
Inspect for loose connections			
Thermal Conductive Heating (TCH) Wells			
Inspect electrical and thermocouple connections			
Confirm all circuit home runs are labeled correctly and located for ease of identification.			
Continuity check on all heater circuits			
Heater resistance at distribution panel: check and record			
Sticker applied to inside lid of well head enclosure.			
Heater junction box covers closed			
Confirm secure ground wire connection on **ALL** heater wells			
Vapor Extraction Wells (VEWs)			
Confirm vapor connections at the wells are connected to the process vapor header via hose			

Thermal

Wellfield Equipment Checklist

Item Description	Problems/Corrective Actions	By	Date
Confirm any sample ports are closed (via valve or plug)			
When VEWs are operational, check for leaks			

Thermal

Wellfield Monitoring Instrument Checklist

Item Description	Problems/Corrective Actions	By	Date
Thermocouple function confirmed (based on ambient temperature reading)			
Confirm temperature/pressure monitoring point wells are properly labeled			
Confirm the heater circuit thermocouples are installed to the proper depths			
Thermocouple wiring checked			
Inspect thermocouple monitoring system - confirm all channels reading			
Confirm baseline temperature data collected			
Dataloggers installed and functional			

Thermal

Electrical Power Checklist

Item Description	Problems/Corrective Actions	By	Date
Main transformer energized and inspected by local utility			
Check wiring at transformers and dist. panels: lugs tight, proper voltage, No-Ox on aluminum connections, etc.			
Check for damaged cable or areas that might require wear protection measures			
Transformers and distribution panels secured			
Proper grounding installed and checked			
Check wiring from distribution panels to process equipment, wellfield, and office trailer			
Verify phase rotation of motors at distribution panels and process equipment			
Panel voltage and high voltage warning labels in place			
Lockout/tagout materials available at site			
Arc flash kit is present			
Wellfield grounding/bonding jumpers in place			
Switchboard penetrations sealed against weather			
Check generator automatic transfer switch (ATS)			

Thermal

Collection & Process System Checklist

Item Description	Problems/Corrective Actions	By	Date
Leak check process vapor piping			
Leak check process liquid piping			
Leak check utility water piping			
Leak check vent piping			
Install flow meters, transmitters, and verify function			
Check packaged equipment vendor's pre-start checklists			
Check motor rotation			
Verify proper belt alignment and tension on belt-driven equipment			
Test function of variable frequency drives (VFDs)			
Check motor amperage draw during operation & compare with rated values			
Wire process system instruments to PLC - confirm communication			
Verify PLC and programming is ready			
Vessels & Tanks			
Verify demister is installed on moisture separators (where applicable)			
Verify pressure and/or vacuum relief valve is at the correct set pressure as specified on P&ID			
Confirm installation and correct operation of level switches/transmitters			

Thermal

Collection & Process System Checklist

Item Description	Problems/Corrective Actions	By	Date
Confirm installation and correct operation of pressure switches/transmitters			
Confirm installation and correct operation of temperature switches/transmitters			
Confirm that all vent lines are opened			
Confirm that all drain valves are closed			
Verify that manway covers and blind flanges are installed and tight			
Verify installation of secondary containment around vessel			
Check that adsorption vessels (for example, GAC vessels) are filled with media			

Thermal

Collection & Process System Checklist

Item Description	Problems/Corrective Actions	By	Date
Blowers			
Verify suction filter elements are installed and spare elements are stocked			
Check set point and operation of any pressure or vacuum relief valves			
Verify bearings have been oiled/greased and spare oil/grease is stocked			
Centrifugal Pumps			
Check rotation			
Verify suction strainers are installed			
Verify bearings have been oiled/greased and spare oil/grease is stocked			
Inspect for any leaks near seal			
Bag Filters			
Verify filter bags are installed and spare bags are stocked			
Verify filter bag lid is tightened and secure			
Inspect nozzle connections - verify there are no leaks			

Thermal

Valve Position Checklist

Item Description	Position	Checked	Date
Verify fail action on actuated valves	As Shown on P&IDs		
Wellfield Vapor Extraction Wells (VEWs) Header Isolation Valve	Closed		
Fresh air inlet	Open		
Equipment & piping drains	Closed		
Equipment & piping sample ports	Closed		
Equipment bypass valves	Closed		
Operating/online equipment isolation valves	Opened		
Spare/backup equipment isolation valves	Closed		
Instrument isolation valves	Opened		

APPENDIX C

TRAFFIC MANAGEMENT PLAN

Prepared for
Pechiney Plastic Packaging, Inc.
South Jordan, Utah

Submitted to
United States Environmental Protection Agency, Region II
New York, New York

Prepared by
Ramboll US Corporation

Date
December 2019

Project Number
1690008019

TRAFFIC MANAGEMENT PLAN

OPERABLE UNIT 3, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE WARREN COUNTY, NEW JERSEY

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FIGURES

Figure C-1: Traffic Plan and Project Facility Layout
Figure C-2: Interior Access Routes – OU3 Work Area

ATTACHMENTS

Attachment A: Work Instruction Procedure – Transportation of Equipment or Supplies Beneath High Voltage (34.5 KV) Electric Power Lines
Attachment B: Work Instruction Procedure - Transport of Diesel Fuel
Attachment C: Work Instruction Procedure - Working in Albéa Molding Room

ACRONYMS AND ABBREVIATIONS

DOT	Department of Transportation
OU	Operable Unit
Plan	Traffic Management Plan
PVGCS Site	Pohatcong Valley Groundwater Contamination Superfund Site
PPPI	Pechiney Plastic Packaging, Inc.
Ramboll	Ramboll US Corporation
TCE	trichloroethylene
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

On behalf on Pechiney Plastic Packaging (PPPI), Ramboll US Corporation (Ramboll) has prepared this Traffic Management Plan (the "Plan") associated with the Operable Unit 3 (OU3) *in-situ* thermal remediation (ISTR) System Construction activities to be implemented at the Albéa facility at 191 Route 31, Washington New Jersey, starting in late 2019. The work is described in the United States Environmental Protection Agency (USEPA)-approved OU3 Remedial Action Work Plan dated July 2019.

The ISTR activities are part of remediation of the Pohatcong Valley Groundwater Contamination Superfund Site (the "PVGCS Site"). The PVGCS Site is located in Warren County, New Jersey, and is identified by the USEPA as ID# NJD981179047.

1.1 Purpose

The purpose of this Plan is to provide the information needed to coordinate the vehicle, equipment, and personnel traffic during the ISTR system construction. This Plan addresses the proposed routes used by drilling equipment, construction equipment, delivery trucks, all contractors and visitors, and pedestrians entering, leaving, and navigating the area. All traffic control aspects contained within this Plan will be maintained throughout the entire period of ISTR system construction and operation. This plan is to ensure the safe movement of traffic and personnel around the work areas, provide maximum protection and safety to site workers, contractors, visitors, and local area residents. Details describing the Plan are presented in the sections below.

2. PRE-OPERATIONAL SAFETY INSPECTION

2.1 Vehicle Pre-Trip Inspection

All personnel traveling to the job site shall perform and complete a vehicle inspection check list. Drivers of light vehicles will conduct a vehicle inspection and record any deficiencies prior to traveling every day. If the deficiency is deemed to present a significant hazard, the vehicle will be tagged out-of-service until it can be repaired. At the end of each month, the driver will submit the completed daily inspection form to Ramboll's Site Safety Officer for documentation.

Drivers of materials and equipment delivery trucks will conduct vehicle inspection per Department of Transportation (DOT) vehicle inspection requirements.

All drivers are required to have valid state-issued driver's licenses for the type of vehicle they operate and up-to-date training/certification for operating heavy equipment and/or mobile equipment.

2.2 Permits for Oversize or Overweight Vehicles

Each state DOT requires vehicles and loads that exceed legal size or weight limits to apply and be in possession of oversize/overweight permits prior to transportation. Interstate permits will be required if the vehicle travels through multiple states to reach its final destination. In the event that the vehicle is both oversize and overweight, two permits may be required. Drivers should comply with routes of travel, speed limits, exact date, and time of operation designated by the Motor Vehicle Commission. All other state DOT statutes pertaining to oversize or overweight vehicle transportation, such as escort vehicle requirements, hazard warning signs, warning flags, head lamps, and tail lamps shall be followed.

3. TRAFFIC MANAGEMENT

All project-related traffic is subject to the Rio Tinto Vehicles and Driving Standard (Document HSEC-B-15). All vehicles proceeding to the work areas or designated storage area(s) for the purpose of conducting work or making deliveries are to follow all posted rules of the road, as well as those detailed in this Plan. The posted speed limit for the Albéa parking lots is 10 miles per hour (mph). There will be no tolerance for illegal or unsafe actions. Rendezvous locations and pre-approved escort routes for material and heavy equipment will be defined during the kick-off meeting.

3.1 Site Areas

A specific access route has been established for the site, including material staging/equipment/ laydown/trailer areas. The primary contractor laydown area will be at the north end of the property. The contractor trailer area will be west of the building. This area will include the contractor tool storage, the contractor office trailer, and contractor's sanitary facilities. The Ramboll trailer will remain in the Albéa lot south of the facility parking lot. This area will be used for waste material roll offs, as a secondary contractor laydown area, and primary parking for all non-essential or non-construction related vehicles. A map of the designated storage/equipment areas, with overhead utility clearances, is provided as Figure C-1.

The Work Instruction Procedure (WIP) for transporting beneath high voltage power lines shall be strictly followed. This WIP is included with this Plan as Attachment A. A map of the project areas overhead electric line is provided as Figure C-1. Additional overhead electric lines will be installed as part of the ISTR construction activities and will be located near the south end of the building at the Albéa gate entrance. As specified in the WIP:

- If the distance between the height of the high voltage electric power line and the planned transit location is less than 20 feet, a Close Proximity Permit will be required prior to transit beneath.
- If the distance between the height of the high voltage electric power line and the planned transit location is less than 6 feet, transit beneath is not allowed without a conference call and authorization by Rio Tinto's Principal Advisor, in addition to the Close Proximity Permit.
- If the distance between the height of the high voltage electric power line and the planned transit location is greater than 6 feet but less than 10 feet, transit beneath is only allowed with a master spotter and two spotters to ensure the truck and load maintains the 6-foot minimum distance from the power lines, and a Close Proximity Permit.
- If the distance between the height of the high voltage electric power line and the planned transit location is greater than 10 feet, transit beneath is allowed with a Close Proximity Permit and a spotter to ensure the truck and load maintains a 10-foot minimum distance from the power lines.

3.1.1 Albéa Delivery Traffic

A sign indicating "Caution Overhead Electrical Wire" will be placed at the south end of the building at the Albéa gate entrance. Contractor will be directed to maintain an open lane for Albéa resin delivery truck traffic arriving from the north Route 31 entrance and proceeding around the north end of the building and along the west side of the building to the resin storage silos. Signage indicating construction areas, possible pedestrian traffic, and revised driveway route will be installed. Full-size barricades will be placed at both ends of the resin delivery truck route along the west side of the building, one barricade near the north staging area and one barricade at the south end of the building at the Albéa gate entrance for any trucks that my come in from this direction. A "slow" sign will also

be added to the barricades. Resin deliveries will be coordinated with Albéa and resin delivery trucks will be escorted along the west side of the building.

3.1.2 Project Traffic

All construction heavy equipment delivery and semi-trucks/trailers will require an escort. Vehicles making delivery of material and equipment will alert Ramboll of their expected arrival and be escorted to the appropriate area.

Ramboll and contractor personal and light weight commercial vehicles will enter from the southern Route 31 entrance and enter the designated project parking area at Ramboll's trailer. This area is one-way, proceeding from east to west past the Ramboll trailer, as shown on Figure C-1. Signage indicating "Construction Entrance" and "Construction Exit Do Not Enter" will be posted at the entrance and exit, respectively, and a stop sign will be located at the Ramboll trailer area. Drivers and operators shall be aware of project workers and Albéa facility employees walking or driving near this area.

All vehicles will be parked in the secondary laydown area near the Ramboll trailer unless it is necessary for the vehicle to be parked elsewhere. Additional parking areas will be determined on an as needed basis by the Ramboll Site Supervisor.

TRS personnel may proceed to the contractor trailer and storage area shown west of the facility building on Figure C-1 with vehicles used to support construction activities. Drill rig, support trucks, and bobcat route to the work area is around the west side of the building to an entrance on the north side of the building as shown on Figure C-1. This route will be used for deliveries to the Equipment Laydown Areas also.

Fuel for the drill rigs and other equipment, which will be stored in a covered and fenced area near the north staging area, will be delivered into the molding room via a rollup door on the north side of the building.

The WIP for transport of diesel fuel shall be strictly followed. This WIP is included with this Plan as Attachment B. As specified in the WIP:

- Bulk diesel fuel tank needs to meet or exceed the RT E-15 document (Hazardous materials and non-mineral waste control and minimization). The mobile tank used to transport from bulk storage into the molding room will be double-walled or have a secondary containment and be no more than 100 gallons in size.
- Make sure a spill kit is readily available and a fire extinguisher is nearby at the bulk tank storage area and in the Molding Room.
- A spotter will walk in front of the forklift on the way to/from the molding room to control all intersections and other traffic (pedestrians and mobile equipment). The spotters roll will be to assist the forklift through congested areas and to make sure other traffic is controlled to prevent quick stops and intersection collisions.

3.1.3 OU3 Work Area Inside Albéa Building

Deliveries and equipment access to the molding room in the Albéa Building will be from the north entrance. No support truck traffic is allowed in the building. Supplies/materials will be transported by propane-fueled or battery powered forklift. Forklifts are required to drive the speed limit inside the building, which is 5 mph, slow down and honk at all intersections, and watch for pedestrians and other

traffic. The interior access route is shown on Figure C-2. In addition, the WIP for working in Albéa molding room shall be strictly followed and is included with this Plan as Attachment C.

4. TRAFFIC CONTROLS

4.1 Ramboll Trailer Area

In addition to the site trailer, a secondary staging area (roll-off boxes if needed) and sanitary facilities will be present in the Ramboll Trailer Area in the south parking lot. This area may be surrounded by a chain link fence to limit trespass. All drivers and operators shall be cautious when approaching this area and other areas of limited visibility. Additional traffic controls may be employed, as necessary.

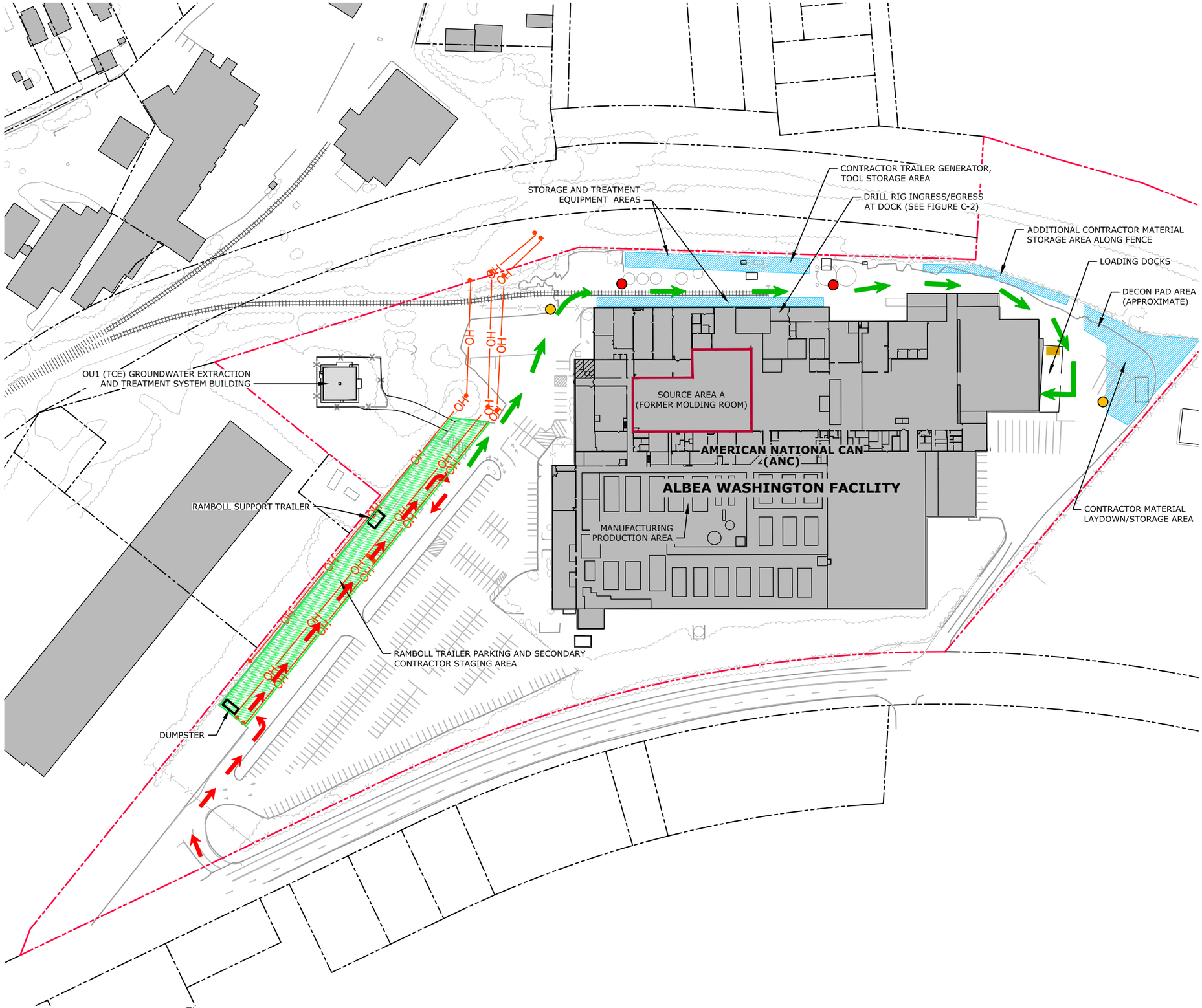
4.2 Contractor Trailer Area

The contractor trailer area will be located west of the Albéa facility building as shown on Figure C-1. The contractor will be required to keep the west side access driveway clear for truck traffic throughout the construction and operation of the ISTR system. Signage will be installed at the north and south edges of the contractor trailer areas. All drivers and operators shall be cautious when approaching this area as the air/liquid treatment, electrical, condensate storage, and associated piping are located near the contractor trailer areas.

4.3 Channeling Devices

Channeling devices, such as cones, signage, or barricades may be used to route traffic as needed. No contractor parking is allowed on the north side of the building. Changes in traffic/routes will be discussed during the preconstruction meeting and daily safety meeting as appropriate. The safety tailgate form will be used to document traffic management changes.

FIGURES



LEGEND

- OU3 BOUNDARY (APPROXIMATE)
- RAMBOLL TRAILER PARKING AND SECONDARY CONTRACTOR STAGING AREA
- DELIVERY AND PERSONNEL VEHICLE TRAFFIC ROUTE
- FORKLIFT AND ESCORTED EQUIPMENT/ MATERIAL DELIVERY ROUTE
- OH — OVERHEAD ELECTRIC LINE
- STOP SIGN
- CONSTRUCTION AREA (SLOW) SIGN

Note:

1. Albea daily deliveries will enter the north driveway an turn around at loading dock area.
2. Albea resin deliveries will enter south driveway and turn around near resin silos.

0 150

SCALE IN FEET

SOURCE: AERIAL IMAGERY: GOOGLE EARTH™, IMAGE DATED xx/xx/201x.

TRAFFIC PLAN AND PROJECT FACILITY LAYOUT

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

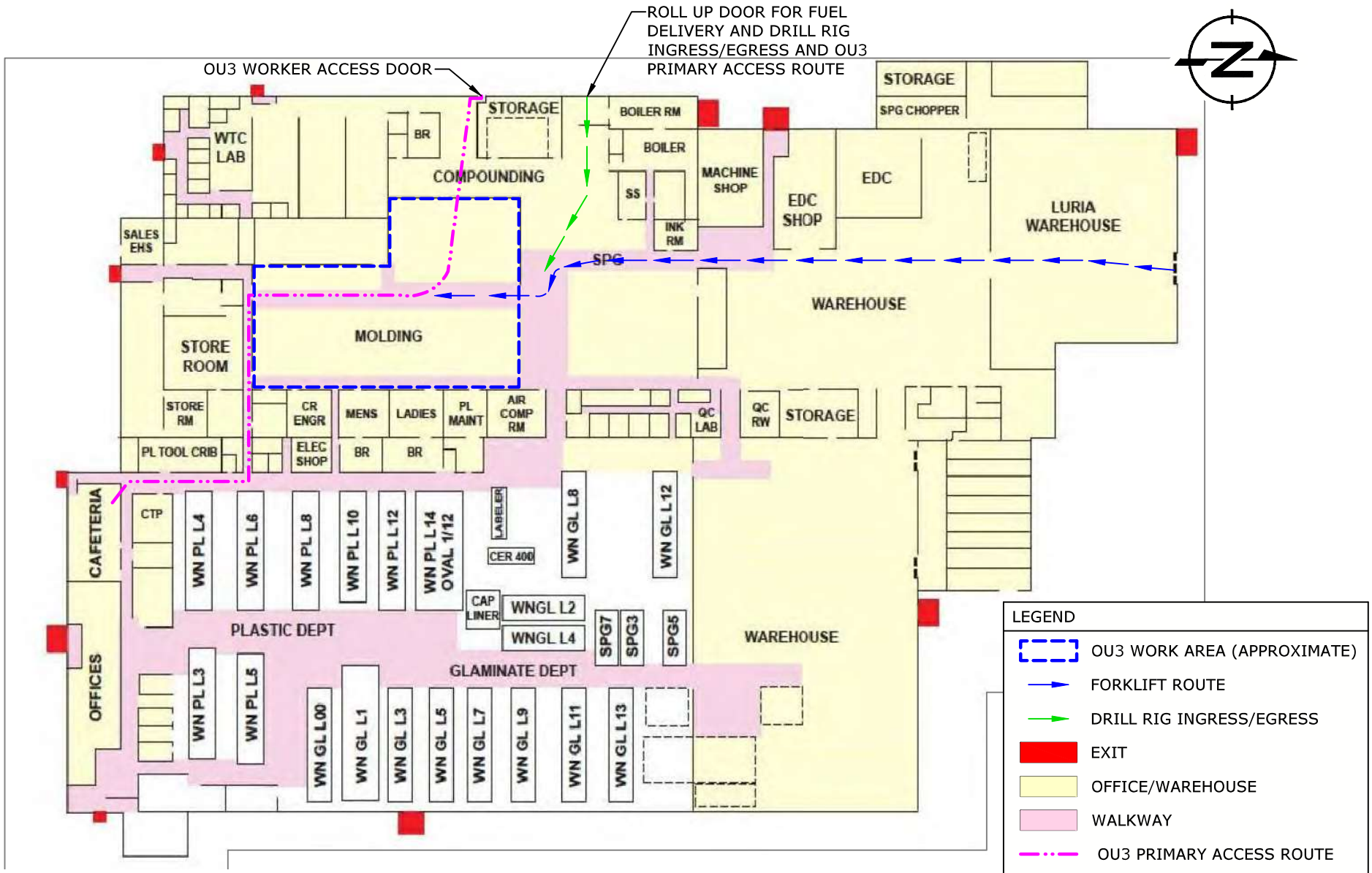
RAMBOLL

FIGURE **C-1**

DRAFTED BY: ELS/CKL	DATE: 7/11/19	1690008019

L:\Loop Project Files_CAD\1690008019_RT_WBS_010\OU3 RA Workplan\C-1_Traffic Plan & Facility Layout (OU3).dwg

L:\Loop Project Files_CAD\1690008019_RT_WBS_010\OU3 RA Workplan\02_Interior Access Route-OU3 Work Area (OU3).dwg



Site map from Albea Washington Plant - Contractor Saftey Package Rev 18 (September 7, 2017).

RAMBOLL

DRAFTED BY: ELS | DATE: 7/25/19

INTERIOR ACCESS ROUTE - OU3 WORK AREA

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

FIGURE
C-2

1690008019

ATTACHMENT A

WORK INSTRUCTION PROCEDURE – TRANSPORTATION OF EQUIPMENT OR SUPPLIES BENEATH HIGH VOLTAGE (34.5 KV) ELECTRIC POWER LINES

Work Instruction Procedure

Project Name: Remedial Action Construction, OU1 (TCE), PVGCS Site
Work Location: Albea Property, 191 Route 31 North, Washington, NJ
Description of the Work Task: Transportation of equipment or supplies beneath high voltage (34.5 KV) electric power lines.

Procedure Prepared by: *Michael Eddings, Date* **Prepared: 7***/8/2015* Update February 2018/CB
Procedure Reviewed by: *Bruce Kennington, Date* **Prepared:** *7/24/2015*
Procedure Approved by: *Bruce Kennington, Date* **Approved:** *7/27/2015*

	Describe the job step-by-step so it is able to be clearly understood by anyone required to do this job
Step 1	Check with the power company (Jersey Central Power and Light; Charles Benner 908-689-6959) to determine if shielding is available for the duration of tasks that will require low clearance transport of equipment and supplies.
Step 2	While meeting delivery truck at rendezvous point, verify that the daily (photograph or copy) truck inspection from DOT log book or complete a truck inspection form before the truck moves onsite.
Step 3	Refer to the drawing "Existing conditions and survey controls" with the surveyed heights of the high voltage (34.5 KV) electric power lines for the location the equipment or supplies plan to transit beneath.
Step 4	Verify the height of equipment or supplies (including the truck or trailer and load). If clearance is less than 20 feet, a "Close Proximity Permit" will be required to be obtained prior to passage beneath the lines is allowed.
Step 5	If clearance (i.e., between the height of the equipment with load and the height of the high voltage electric power lines at the planned transit location) is less than 6 feet, no movement of the equipment or supplies beneath the power lines will be permitted until authorization is obtained following a "GO/NO GO" conference call held with the project team, including the contractor Site Supervisor, the contractor Site Safety officer, the Ramboll Senior Construction Manager, the Ramboll Site Manager, and the Rio Tinto Principal Advisor HSE.
Step 6	If the clearance of the truck and load is determined to be greater than 6 feet but less than 10 feet, a master spotter with two spotters will be used to ensure the truck and load maintains the 6-foot minimum distance from the power lines.
Step 7	If clearance of the truck and load is greater than 10 feet, a single spotter will be used to help ensure the truck and load maintains a 10-foot minimum distance from the power lines.
	Describe the hazards likely to be encountered when doing the job (From pre-task hazard assessment or risk assessment)
	Slips, trips and falls while observing/walking the truck or trailer beneath the power lines.
	Equipment or supplies come in contact with the power lines.
	Electrical shock to spotters or driver if procedures are not followed.
	Describe how the hazards are going to be controlled (Use of HSE Performance Standards or other procedures)
	Drivers will be escorted on Site by Ramboll or contractor authorized personnel
	Rio Tinto Performance Standard C3 - Vehicles and Driving
	Use of spotters to maintain/verify the load will pass beneath the power lines while maintaining the required minimum distance from the power lines.
	No personnel will be allowed to ride on the trailer or in equipment while driver of the truck passes beneath the power lines.
	Driver will not be allowed to exit the truck until the load has cleared the power lines.
	Drivers will be required to use the appropriate PPE when unstrapping the equipment/supplies. (Hard hat, safety glasses, gloves, steel toe boots)
	List training or competencies required
	General electric safety
	Knowledge of working with/near heavy construction equipment and trucks
	Contractor Indoctrination Training for the Site
	Operator loading or unloading of the equipment/supplies will be qualified on the specific equipment used.
	List PPE Required
	Non-Conductive hard hat
	High-visibility vest
	Steel-toe boots
	Safety glasses
	List any precautions, notifications or permits required
	Must understand other site activities and associated hazards
	Must pay attention to location of truck/trailer while watching the power line clearance
	Must pay attention to ground surface while watching truck and power line clearance
	All personnel on Site will be informed of the movement of equipment or supplies at the daily tailgate meeting.
	Personnel performing tasks in the area of the movement of equipment/supplies will also discuss the associated hazards and controls during the Take-5 meetings.
	Delivery trucks may be asked to provide a copy of the DOT log book inspection section.
	An equipment inspection will be performed before the equipment will be placed in service.
	If clearance is less than 20 feet a "Close Proximity Permit" will be required to be obtained prior to passage beneath the lines is allowed.
	Emergency Action Procedure
	Move away from the equipment that has come in contact with the electric power line(s). Driver or operator should remain within the vehicle.
	If a high voltage line has been broken, move away from the line. **DO NOT CROSS.**
	CALL 911……DO NOT ATTEMPT A RESCUE. THE FIRE DEPARTMENT RESCUE TEAM WILL DO WHAT IS NEEDED TO SAFELY EXTRACT AFFECTED PERSONNEL or EQUIPMENT.

GPS # 1 INSET

GPS # 2 INSET

GPS # 3 INSET

GPS # 4 INSET

NOTES:

1. INFORMATION SHOWN HEREON IS BASED ON AERIAL AND GROUND SURVEYING PERFORMED BY GEOD CORPORATION AND RECORD INFORMATION OBTAINED PRIOR TO PERFORMING THE FIELD SURVEY.

2. UNDERGROUND UTILITY LOCATIONS ARE BASED ON A FIELD MARKOUT PERFORMED BY ENVIRON CORPORATION AND REFERENCE MAPS PROVIDED BY THE CLIENT. UTILITIES SHOWN HEREON SHOULD BE REMARKED PRIOR TO EXCAVATION TO ENSURE THE ACCURACY OF ALL UNDERGROUND UTILITIES.

3. THIS PLAN HAS BEEN PREPARED WITHOUT THE BENEFIT OF A TITLE REPORT. PROPERTY MAY BE SUBJECT TO RESTRICTIONS, COVENANTS AND/OR EASEMENTS EITHER WRITTEN OR IMPLIED THAT A CERTIFIED TITLE REPORT MAY DISCLOSE.

4. HORIZONTAL DATUM IS NORTH AMERICAN DATUM OF 1982 (NAD83)(CORS (NEW JERSEY 2900)

5. VERTICAL DATUM IS NATIONAL GEODETIC VERTICAL DATUM OF 1988 (NAVD 88). VERTICAL DATUM IS BASED UPON NATIONAL GEODETIC SURVEY(NGS) PID • BV1614; DESIGNATION • B 222; STATE/COUNTY • NJ/WARREN; USGS QUAD • BELVIDERE (1992) ; CURRENT SURVEY CONTROL NAD 83(1986)• 40 45 30 (N) 075 00 00 (W) HAVING A NAVD 88 ELEVATION 128.723 (meters) 422.32 (feet). THIS WAS CHECKED WITH (NGS) BV1616 • RADIUS & BV1262 • R 15

5. CONTOUR INTERVAL IS ONE (1) FOOT

7. UNITS ARE US SURVEY FEET

LEGEND

SIGN SINGLE POST	TRAVERSE
SIGN DOUBLE POST	WATER MANHOLE
SMALL DECIDUOUS TREE 9" OR SMALLER	WATER VALVE
MEDIUM DECIDUOUS TREE 9" TO 18"	WATER VALVE
LARGE DECIDUOUS TREE 19" OR LARGER	ELECTRIC MANHOLE
BUSH OR SHRUB	PROTECTIVE POST
MEDIUM CONIFEROUS TREE 9" TO 18"	DOUBLE CATCH BASIN
LARGE CONIFEROUS TREE 19" OR LARGER	STAND PIPE
MONITORING WELL	UNKNOWN MANHOLE
GAS VALVE	GAS LINE
TRASH BARREL	WATER LINE
LARGE ROCK / BOULDER	ELECTRIC LINE
DOUBLE LIGHT POLE	DRAINAGE LINE
UNKNOWN VALVE	SANITARY LINE
WOOD UTILITY POLE	
FENCE POST	BUILDING LINE
FLAG POLE	BOTTOM SLOPE LINE
ELECTRIC BOX RECTANGULAR	METAL GUIDERAIL
GUY WIRE	CHAIN LINK FENCE LINE
METAL LIGHT POLE	
FIRE CALL BOX	

NJSPCS (NAD 83)

NEW JERSEY STATE HIGHWAY ROUTE 31 NORTH

BLOCK 39 LOT 1

BLOCK 39 LOT 2

BLOCK 39 LOT 3

BLOCK 39 LOT 4

BLOCK 39 LOT 5

BLOCK 39

FK NAIL #1

FK NAIL #2

FK NAIL #3

FK NAIL #4

FK NAIL #5

FK NAIL #6

FK NAIL #7

FK NAIL #8

FK NAIL #9

FK NAIL #10

FK NAIL #11

FK NAIL #12

FK NAIL #13

FK NAIL #14

852' TT

BLOCK 37 LOT 1
NF TWIST BEAUTY PACKAGING ES, INC.
DEED BOOK 2726 PAGE 168

BLOCK 37, LOT 1
LANDS N/F
AMERICAN NATIONAL CAN
D.B. 1643, PG. 347

#191
ONE STORY BRICK
MANUFACTURING BUILDING

2 STY.
CONCRETE
COMMERCIAL BUILDING

BLOCK 37
LOT 4

BLOCK 37 LOT 2
N/F TWIST PACK
DEED BOOK 000 PAGE 00

BLOCK 37
LOT 1

BLOCK 37 LOT 4
TRACK 1

4.8 N9

12.5 N9

34.5 N9

N35°39'12"E
324.93'

S35°39'12"E

12" RCP

APPROXIMATE LOCATION OF JERSEY CENTRAL POWER AND LIGHT COMPANY EASEMENT (TAX MAP 167, BLOCK 39)

APPROXIMATE LOCATION OF VERIZON EASEMENT

MATCH LINE SHEET 2

MATCH LINE SHEET 3

① ② ③

Sheet layout

Graphic Scale
(In Feet)
1 inch = 40 ft.

GEOD CORPORATION
GEOGRAPHIC SCIENCES • SURVEY TECHNOLOGIES
CORPORATE OFFICE:
24 Kenosia Rd., Hackettstown, N.J. 07840 • (973) 813-4122 FAX (973) 729-6433
Certificate of Authorization # 24GA27000700

Revisions		
04/27/12	S.D.V.	DTM AT PROPOSED BLDG 3
11/08/11	E.A.	CTN WIRE CLEARANCES ADDED
04/19/11	E.A.	PER DRU'S COMMENTS
08/17/06	WFF	ADD NEW UTILITY MARKOUT
DWG.	BY	DESCRIPTION

EXISTING CONDITIONS AND SURVEY CONTROLS
OF THE
ALCAN PACKAGING FACILITY
PREPARED FOR
ENVIRON

Borough of Washington — Warren County — New Jersey

Drawn By:	E.A.
Checked:	B.C.M.
Scale:	1"=40'
Date:	02/22/11
Proj. No.	2660
Page:	1 of 3

PAUL J. EMILIUS Jr.
N.J. Professional Land Surveyor Lic. No. 21106

ATTACHMENT B

WORK INSTRUCTION PROCEDURE – TRANSPORT OF DIESEL FUEL

Work Instruction Procedure

Project Name: Remedial Action Construction, OU3(TCE), PVGCS Site
Work Location: Albea Property , 191 Route 31 North, Washington, NJ
Description of the work task: Transport of diesel fuel to the molding room and the refueling of the drilling equipment

	Describe the job step-by-step so it is able to be clearly understood by anyone required to do this job
Step 1	Bulk diesel fuel tank needs to meet or exceed the RT E-15 document (Hazardous materials and non-mineral waste control and minimisation). The mobile tank will be double-walled or have a secondary containment and be no more than 100 gallons in size. Make sure a spill kit is readily available and a fire extinguisher is nearby at the bulk tank storage area and in the Molding Room. Verify all fuel pumps and hoses are in proper working order on bulk fueling tank
Step 2	Pick up mobile tank with forklift and strap down the tank to secure it for transport.
Step 3	Fill the mobile tank with diesel fuel. Be sure to not overfill. If overfill or other leakage occurs, clean off the tank before transporting into the facility.
Step 4	After mobile tank is filled, properly secured, and clean it is ready to proceed toward the north roll up door of the facility. Make sure a spill kit is readily available and a fire extinguisher is nearby during transport into the building.
Step 5	A spotter will walk in front of the forklift on the way to the Molding Room to control all intersections and other traffic (pedestrians and mobile equipment). The spotters roll will be to assit the forklift through congested areas and to make sure other traffic is controlled to prevent quick stops and intersection collisions.
Step 6	Once in the Molding Room, and before fueling of the drilling equipment starts, verify the spill kit is readily available and the location of fire extiguishers in the Molding Room.
Step 7	Turn drilling equipment off. Begin fueling equipment.
Step 8	After fueling is complete, clean up any spills, drips, etc from equipment and fuel tank.
Step 5	A spotter will walk in front of the forklift on the way out of the Molding Room to control all intersections and other traffic (pedestrians and mobile equipment). The spotters roll will be to assit the forklift through congested areas and to make sure other traffic is controlled to prevent quick stops and intersection collisions.

Describe the hazards likely to be encountered when doing the job(From pre task hazard assessment or risk assessment)
Overfilling causes spill and catches on fire and/or creates slip conditions.
Slips, trips, and falls while escorting the forklift to/from the Molding Room.
Tank not properly secured and sudden stops or turns causes the tank to be dropped, spilling fuel onto the ground or inside the building.
Forklift strikes pedestrian or object while moving to/from the Molding Room.

Describe how the hazards are going to be controlled (Use of HSE Performance Standards or other procedures)
Pay attention for the level in the tank or equipment being filled refueled.
Use of spotters to maintain traffic control at intersections and congested areas.
Training and competency of personnel involved in refueling activities.
Have spill pad, pan, etc to catch any spill that might occur while fueling.
Have fire extinguisher nearby in case of fire.
Honking the horn of the forklift while moving through the facility.

List training or competencies required
Forklift training
Knowledge of working with/near heavy construction equipment and trucks
Contractor Indoctrination Training for the site
Fire extinguisher use awareness and training
Operator loading or unloading of the equipment/supplies will be qualified on the specific equipment used.

List PPE Required
Hard hat
High-vis vest
Steel toe boots
Safety glasses
Gloves

List any precautions, notifications or permits required
Must understand other site hazards (construction of treatment system, operating plant)
Must pay attention to ground surface while acting as spotter.
An equipment inspection will be performed before equipment is placed in service.

Emergency Action Procedure
For minor spill - Contain and clean up with spill kit. Report spill.
For major spill - Contain fuel as to not get into a receptor. Call for assistance. Report spill.
For small fire - Use a fire extinguisher to put out fire. Report the incident.
For large fire - Evacuate the area or building. Call 911. Notify the appropriate onsite personnel. Report the incident.

ATTACHMENT C

WORK INSTRUCTION PROCEDURE – WORKING IN ALBÉA MOLDING ROOM

Work Instruction Procedure: Working in Albea Molding Room

Project Name: PVGCS Site
Work Location: Albea, 191 Route 31 North, Washington, NJ
Description of the work task: Construction and installation of treatment system and drilling activities
Date: Nov 2019

	When working in the Albea molding room, workers must adhere to the following:
1	All Ramboll/subcontractors must sign the Ramboll sign-in sheet during the start-of-shift tailgate meeting or upon entering the building.
2	The sign-in sheet must be in a location in the OU3 work area that is designated by Albea and is readily accessible to bring to the rally point in the event of a plant evacuation.
3	Ramboll and subcontractors shall complete Albea's Contractor Check List at least for every 10-day shift. The checklist must be kept with the daily sign-in sheet.
4	All Ramboll//subcontractors will be given a Ramboll subcontractor badge that is to be worn when inside the Albea building in lieu of the Albea visitor sticker.
5	All Ramboll/subcontractors will access the OU3 work area using the door by the SVE system if not traversing with a drill rig or forklift.
6	All Ramboll/subcontractors are to park in the parking lot to the Ramboll field trailer. Parking is prohibited in the main Albea parking lot, on the east side of the back driveway, and in the north canopy area. Standing on the east side of the back driveway and/or in the north canopy area for short term deliveries are allowed. Parking on the west side of the back driveway may be allowed with permission from the Ramboll field manager.
7	All Ramboll/subcontractors will be restricted to the Molding Room, the restrooms (east of Molding Room), and the lunch room (southeast of Molding Room). However, in December 2019 only, work in the production area will be allowed during scheduled drilling activities.
8	All Ramboll/subcontractors must wear a hairnet and, if applicable, a beard net at all times while inside the facility (except lobby). Standard PPE (safety glasses, steel toe boots, hard hat, hi-vis vest, and hearing protection) shall be worn in the OU3 work area also. Note, contact lenses and jewelry are not allowed in the Albea plant. See attached checklist for Albea PPE requirements.
9	All Ramboll/subcontractors are prohibited from eating/drinking/chewing in the Molding Room or any other Albea indoor area except the lunchroom. Bottled water in a clear container is allowed.
10	Part of Albea's Hygiene Plan includes washing hands before leaving bathrooms.
11	Personal use of cell phones is not allowed in the plant. Smoking is allowed only at the Albea smoke hut east of the plant.
12	All Ramboll/subcontractors are to evacuate the plant upon the signal and move to the rally points.
13	The OU3 work area's exclusion zone is to be clearly marked by signs or cones or tape to warn Albea employees to stay out.
14	Dust generation will be minimized. No mixing of grout is allowed inside the building. Use dust controls as needed and/or if requested by the Ramboll field manager.

Describe the hazards likely to be encountered when doing the job (From pre task hazard assessment or risk assessment)
Hazards include drilling hazards as listed elsewhere, tripping over exhaust hoses, interior forklift traffic, 2nd shift work (low light/fatigue), TCE from subslab, cold stress, heat stress, dust generation, diesel exhaust, welding fumes/UV radiation and fire.

Describe how the hazards are going to be controlled (Use of HSE Performance Standards or other procedures)
Engineering controls: Work area demarcation. Use water to control dust. Exhaust ventilation. Use welding screens/curtains/blankets. Fire watch. LOTO.
Administrative controls: Limit work hours as agreed with Ramboll and Albea (hours may be different depending on the task). Sign in and out with Ramboll site safety officer. Park in approved parking zones. Use designated access routes to Molding Room. No grout mixing inside the building. Maintain daily sign-in sheet and weekly Albea checklist as required.
Personal protective equipment (PPE): See below.

List training or competencies required
Site-specific Contractor Indoctrination Training. NJ-licensed drillers. Licensed/trained electricians. Trained equipment operators.
Daily toolbox meeting to discuss changing conditions or requirements.

List PPE Required
Standard PPE: Hard hat, steel-toed boots, long pants, safety glasses, gloves, hi-vis vest, and (properly rated) hearing protection, where required
Personal fall arrest when required. Welding gloves/helmet when required.
Albea additional PPE requirements (see attachment for full list): All contractors must wear hair net and, if applicable, beard net at all times while inside the facility (except lobby). Contact lenses are not allowed in the Albea plant. Jewelry, including watches is not allowed in the Albea plant.

List any precautions, notifications or permits required
Isolation permit. Hot work permit (30 to 90 minute fire watch). Working from heights permit.
Conduct SSC for all subsurface work.
Questions? Contact the Michael Eddings, Ramboll On-site Field Manager. Albea contact for OU3: Felix Miranda 908-619-2159 or Russell Gladd 908-674-1479.

APPENDIX D

FIELD SAMPLING PLAN

Prepared for:
Pechiney Plastic Packaging, Inc.
South Jordan, Utah

Submitted to:
United States Environmental Protection Agency Region II
New York, New York

Date:
December 2019

Project Number:
1690008019

FIELD SAMPLING PLAN

OPERABLE UNIT 3, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE WARREN COUNTY, NEW JERSEY

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RAMBOLL

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ATTACHMENT

Attachment 1: ISTR Specific Standard Operating Guidelines and Procedures

ACRONYMS AND ABBREVIATIONS

AC1	Area of Concern 1
°C	degree Celsius
°F	degree Fahrenheit
Albéa	Albéa Americas, Inc.
ANC	American National Can
AST	aboveground storage tank
bgs	below ground surface
CD	Consent Decree
DL	drain lines
EB	equipment blank
EDD	electronic data deliverable
EQuIS	Environmental Quality Information Systems
eV	electron volt
EVS	Earth Volumetric Studio
FB	field blank
FSP	Field Sampling Plan
GWETS	Groundwater Extraction Treatment System
HASP	Health and Safety Plan
ISTR	in-situ thermal remediation
mg/kg	milligram per kilogram
MPA	Main Production Area
MS/MSD	matrix spike/matrix spike duplicate
OM&M	Operation, Maintenance, and Monitoring
OU	Operable Unit
PCE	tetrachloroethene
PDI	Pre-Design Investigation
PID	photoionization detector
PPE	personal protective equipment
PPPI	Pechiney Plastics Packaging, Inc.
PVGCS	Pohatcong Valley Groundwater Contamination Superfund
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RA	Remedial Action
RAWP	Remedial Action Work Plan
RD	Remedial Design
RG	remedial goal
RI/FS	Remedial Investigation/Feasibility Study

ROD	Record of Decision
Site	Pohatcong Valley Groundwater Contamination Superfund Site
SOG	standard operating guideline
SOP	standard operating procedure
SOW	Statement of Work
SSD	Sub-slab Depressurization
SSDS	Sub-Slab Depressurization System
TB	trip blank
TCE	trichloroethene
TCH	thermal conductive heating
TCLP	Toxicity Characteristic Leaching Procedure
TTZ	target treatment zone
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VIRA	Vapor Intrusion Remedial Action
VMP	vapor monitoring probe
VOC	volatile organic compound
VTC	Vikon Tile Corporation
WLY	Warren Lumber Yard

1. INTRODUCTION

Ramboll US Corporation (Ramboll) has prepared this Field Sampling Plan (FSP) for Source Area A of Operable Unit (OU) 3 of the Pohatcong Valley Groundwater Contamination Superfund (PVGCS) Site, hereinafter referred to as the "Site," located in Warren County, New Jersey (United States Environmental Protection Agency [USEPA] identification number NJD981179047). This FSP was prepared on behalf of Pechiney Plastics Packaging, Inc. (PPPI) for the remedy selected by the USEPA to address trichloroethene (TCE) impacts in deep vadose zone soils for OU3 (Source Area A).[1] The FSP is submitted in compliance with Section IX of the USEPA-approved Statement of Work (SOW)[2] for OU3 and the Consent Decree (CD)[3] and presents the field sampling procedures and methodology required for collecting the necessary data to evaluate attainment of the remedial goal (RG) and objectives identified in the USEPA Record of Decision (ROD)[4] for OU3 (Source Area A).

1.1 Objective

This FSP describes the sampling activities associated with the pre-and post-operation of the *in-situ* thermal remediation (ISTR) system including final performance verification sampling needed to provide confirmation of RG achievement. The FSP will be used in conjunction with the February 2018 Quality Assurance Project Plan (Revision 9) (QAPP), Waste Management Plan (included as Appendix E of the Remedial Action Work Plan [RAWP}), and Site-specific Health and Safety Plan (HASP) developed for the ISTR remedy (included as Appendix G of the RAWP). The complementary QAPP and HASP provide the quality assurance (QA) and quality control (QC) and health and safety procedures that will be used throughout the project to ensure that consistent and documented means, methods, and practices are implemented for the work. The Waste Management Plan provides details and specific information on the management and disposal of investigation-derived wastes that will be generated during implementation sampling activities. This FSP describes the specific field sampling activities that will be conducted to collect the required data to provide verification of successful performance and completion of the soil remedial activities for OU3 Source Area A. These data will be incorporated into the Remedial Action Completion Report, which is a subsequent deliverable under the USEPA-approved SOW for OU3.

1.2 Document Organization

This FSP is organized into eight sections. Section 1 (this section) introduces this FSP, summarizes the intent, and references the complementary QAPP and HASP. Section 2 describes the Site history and geologic/hydrogeologic setting. Section 3 provides details of the field sampling methods and activities to be performed during construction of the OU3 remedy relating to the confirmation of the extent of TCE impacts >1 milligram per kilogram (mg/kg) within the Main Production Area (MPA) of the Albéa Americas, Inc. (Albéa) Washington facility, and to verify the performance of the selected remedy in meeting the remedial goals and objectives. Section 4 provides the nomenclature to be used for sample identification. Section 5 describes the procedures for conducting field measurements, field quality control, and decontamination of equipment in accordance with the project QAPP. Section 6 specifies the recordkeeping that will be done to document sample collection, custody, and shipping. Section 7

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[1] The remedy selected by USEPA for the treatment of soils in OU3 Source Area A is in-situ thermal remediation (ISTR) via thermal conductive heating (TCH).

[2] USEPA approval of the OU3 Statement of Work in a letter dated June 26, 2017.

[3] In the matter of United States of America v. PPPI (Civil Action No. 09-cv-05692) and United States of America v. Bristol Myers Squibb Company, et. al. (Civil Action No. 13-cv-05798) effective March 11, 2015.

[4] USEPA Record of Decision – OU3 Study Area dated September 30, 2016.

discusses the management of investigation derived wastes. Section 8 includes a list of references used in the preparation of this FSP. Field standard operating procedures (SOPs), laboratory analytical methods, and QA/QC procedures are specified in the QAPP. Additional ISTR specific standard operating guidelines (SOGs) and SOPs specifically developed for sample collection for ISTR operations and not included in the QAPP are described in Section 3 and Attachment 1.

2. BACKGROUND

This section provides background information on the Site including the location, Site history, and geologic and hydrogeologic setting of the Site.

2.1 Site Location

The PVGCS Site encompasses an area of about 16.5 square miles (10,600 acres) that extends about 8.5 miles along the length of the Pohatcong Valley, which is a northeast-southwest trending valley bounded by mountains. The location of the PVGCS Site is shown in Figure D-1. The Site is divided into three operable units. Operable Unit 1 (OU1), which covers about 8.75 square miles extending about 5 miles along the Pohatcong Valley, is defined by the USEPA as the study area established to address TCE and tetrachloroethene (PCE) contaminated groundwater within Washington Borough, and parts of Washington and Franklin Townships. Operable Unit 2 (OU2) is defined by the USEPA as the portion of the Site downgradient from OU1 where TCE is present in groundwater. The OU3 Study Area is located in Washington Borough and is defined by the USEPA as the area that has been identified as the source area for TCE within the aquifer. The OU3 Study Area comprises four properties known as: American National Can (ANC), Area of Concern 1 (AC1), Vikon Tile Corporation (VTC), and Warren Lumber Yard (WLY) properties. A site map showing the location of OU3 is presented on Figure D-2.

The currently active facility on the ANC property consists of one main building, which houses administrative offices, production facilities, raw and waste materials storage areas, and warehouse shipping and receiving operations for the current property owner, Albéa. The eastern portion of the ANC property consists of unused, vegetated land that borders State Highway 31. The northern portion of the ANC property is a shipping and receiving area that includes loading docks, equipment storage areas, and raw materials and drum storage. A local control panel and four injection wells for discharge of treated effluent from the Groundwater Extraction and Treatment System (GWETS) for OU1 (TCE in groundwater) are also located at the north end of the ANC property. To the west of the ANC building is a paved area that contains raw material storage silos, a water tower, an aboveground storage tank (AST) and pump house for the fire suppression system for the facility, electrical distribution equipment, a fifth injection well for the GWETS, and the sub-slab depressurization blower shed and off-gas treatment equipment for the sub-slab vapor intrusion mitigation system installed as part of the Vapor Intrusion Remedial Action (VIRA) in 2013.

Source Area A within OU3 has been defined as the soils beneath the southwestern portion of the ANC building, also known as the Former Molding Room Area inside the building and drain lines (DL) DL-9 and DL-10, which connect to discharge structures on the down slope portions of the ANC property and originate in the Former Molding Room Area of the ANC building (USEPA, 2016a). Recent Pre-Design Investigation (PDI) activities conducted from March to June 2018 within the Former Molding Room Area and from December 24, 2018 to January 1, 2019 in the MPA located east of the Former Molding Room identified that soil impacts are located beneath a majority of the Former Molding Room Area and also extend to the east and beneath the MPA of the facility.

2.2 Site History

In 2011, the USEPA initiated OU3 Study Area Remedial Investigation/Feasibility Study (RI/FS) activities to determine the nature and extent of contamination. The RI included an evaluation of potential human health and ecological risks based on Site-related contamination in soil, sediment, surface water and indoor air. As a result of these activities, the USEPA issued a ROD for OU3 in September 2016. As provided in the OU3 ROD and SOW, the major components of the USEPA-selected remedy for OU3 include the following:

- The implementation of deep soil vapor extraction and/or thermal treatment to address deep soil contamination underlying the former ANC building.
- Long-term operation and maintenance of the existing shallow sub-slab depressurization (SSD) system within the former ANC building.
- Long-term groundwater and indoor air monitoring in the OU3 Study Area.
- Continued implementation of institutional controls, including the existing deed notice, and amendment to reflect the components of the selected remedy for OU3 that will be implemented at the former ANC property.

PPPI is conducting the remedial activities at the PVGCS Site pursuant to the CD that became effective on March 11, 2015. The OU3 Source Area A soil treatment portion of the project is being performed in accordance with the OU3 SOW, which defines the requirements for implementation of the Remedial Design (RD), the Remedial Action (RA), and Operation, Maintenance and Monitoring (OM&M) Plan for OU3. The OU3 SOW was approved by the USEPA on June 26, 2017, and incorporated into the CD.

During Summer 2013, as part of the VIRA, a vapor mitigation system consisting of shallow sub-slab soil vapor extraction points was installed in the Former Molding Room Area and MPA to mitigate exposure to TCE vapor inside the building. The SSD System (SSDS) description, installation, and operation, maintenance, and monitoring are described in the OM&M Plan for the vapor intrusion response activities at the Albéa Washington facility (Ramboll Environ, 2015).

2.3 Site Geology and Hydrogeology

The PVGCS Site is located within the Pohatcong Valley, which falls within the Reading Prong portion of the Highlands Physiographic Province, locally referred to as the New Jersey Highlands Province. This province is characterized by northeast-southwest trending ridges and valleys of Late Precambrian metamorphic and igneous rocks, and Early Palaeozoic carbonate rock.

The Pohatcong Valley trends northeast-southwest and is bounded on the southeast and northwest sides by regional faults (the Pohatcong Thrust Fault along the southeast side and the Brass Castle Thrust Fault along the northwest side). A third fault (the Karrsville Thrust Fault) is suspected to be present along the Valley floor. The topographic ridges to the southeast and northwest of the Valley floor are both formed from relatively hard and erosion-resistant igneous and metamorphic rocks of Precambrian Age that were thrust up in the area during the Paleozoic Era. The Valley floor is underlain by Early Paleozoic (Cambrian and Ordovician) units that are primarily composed of carbonate rocks (limestones and dolomites) of the Jackson Limestone and the Kittatiny Supergroup. The Kittatiny Supergroup includes the Leithsville Formation, Allentown Dolomite, Lower Beakmantown Group, and the Upper Beakmantown Group. The upper part of the Valley where the existing groundwater extraction and treatment system is operated is underlain by the Leithsville Formation, which is characterized as an approximately 1,000-foot thick unit that consists of dolomite, calcitic dolomite, and phyllite with thin beds of dolomite-cemented quartz. This formation and the other bedrock formations located farther down the Valley contain numerous karstic

features (i.e., sinkholes, caves, large fractures, and cavities) and are primarily composed of carbonate units that readily form karst.

The carbonate rocks under the Valley floor are overlain by unconsolidated sedimentary deposits of glacial origin, primarily glacial till, glacial moraine, and glacio-fluvial deposits that range in thickness from about 40 feet near the boundary between OU1 and OU2 (i.e., down valley) to about 100 feet near the northeastern boundary of OU1. These glacial deposits are generally characterized as a heterogeneous and poorly sorted mixture of gravel, sand, silt, and clay. In most areas, this material has a low permeability and is primarily composed of clayey silt. Slightly greater permeability is encountered in some strata that contain silty sand and gravel lenses.

The glacial till, moraine and fluvial unconsolidated overburden deposits immediately below the building are characterized as predominantly silt to approximately 88 feet below ground surface (bgs) to 109 feet bgs. The silt coarsens downward often becoming sandier towards the bedrock interface. The silt is characterized by having trace cobbles and boulders, is dry, and hard. In some boreholes, a cobble or boulder layer was encountered. These layers ranged in length and depth. The shallowest boulder/cobble layer was encountered around 16 feet bgs while the deepest cobble/boulder layer was encountered around 90 feet bgs. Below the silt overburden, weathered dolostone/limestone bedrock is encountered.

Groundwater in the Pohatcong Valley is found in perched zones within the unconsolidated deposits and in a regional aquifer in the deep overburden and bedrock. Although some perched water zones are present, they do not represent a significant source of groundwater for the region; are generally isolated from each other; and do not form one coherent aquifer. The regional bedrock stratum is primarily composed of fractured and karstic dolomite. Groundwater in the regional aquifer is generally encountered at a depth of approximately 80 to 120 feet bgs in the northern part of OU3 where active remediation is proposed and at progressively shallower depths farther down valley (i.e., towards the southwest). The depth to groundwater at POHMW12R located within OU3 Source Area A ranges from approximately 120 feet bgs to 129 feet bgs.

3. FIELD SAMPLING PROGRAM

The field sampling program presented in this FSP includes activities associated with pre-and post-remediation sample collection for final ISTR performance verification. Data collected from the field activities described herein will support the performance evaluation of the remedy and provide confirmation of RG achievement. Details on the OM&M activities associated with the ISTR system operations and performance monitoring to be conducted during active remediation are presented in the OM&M Plan (Appendix F to the RAWP).

3.1 Soil Sampling During ISTR System Installation

To confirm the extent of the soil TCE impacts >1 mg/kg to the south of PDI-SB32 and to the north of PDI-SB33, which is currently defined by the Earth Volumetric Studio (EVS) model output using the data from the PDI conducted during the plant shutdown on December 24, 2018 through January 1, 2019, soil samples will be collected from two to four soil borings. One to two borings will be installed at the north and south ends of the plume edge for a total of two to four borings. The proposed locations of the initial soil borings to the north and south are shown on Figure D-3. Rotosonic drilling methods will be used to advance a core-barrel to the target depth interval for soil sample collection. Soil samples will be collected between the depths of 75 to approximately 120 feet bgs using the same sampling methods and procedures during the PDI. The soil sampling procedures to be used for soil sample collection are

described in detail in the Pre-Design Soil Sampling and Analysis Plan (Ramboll, 2018b). These data will be used to verify the EVS modeled extent of the TCE impacts south of PDI-SB32 and north of soil boring PDI-SB33, and to ensure that the remedy is sufficiently designed to treat the soil volume exceeding 1 mg/kg at these two locations.

Soil samples collected from the drilling operations will be analyzed using a fixed-base laboratory with results requested on a 2 or 3-day turn-around time. The laboratory will analyze the soil samples for volatile organic compounds (VOCs) and percent moisture and will be used to make decisions on delineation in the field without delay or stand-by of drill rigs and personnel.

3.2 Post-Treatment Soil Verification Sampling

Once ISTR system performance monitoring data indicate that the remedy is near or at completion based on performance metrics such as temperature, energy input, and vapor sampling results and if additional empirical data are requested by the USEPA to demonstrate that the RG has been met, post-treatment soil verification sampling activities will be conducted. The post-treatment soil sampling locations, means and methods, and sample collection procedures are described in further detail in the following subsections.

3.2.1 Sampling Locations

If post-remediation soil sampling is requested by the USEPA, up to two soil borings will be installed within each of the three heater Groups (Group A, Group B and Group C) for a total of up to six post-remediation soil borings. Draft locations (which may be adjusted in the field) for post-remediation soil sample borings are shown on Figure D-4. For the post-remediation soil sampling performed within the area of the Group A and Group B heaters (if needed), borings are proposed be installed when access can be secured during a planned facility shutdown in the Main Production Area. For the post-remediation soil sampling performed within the area of the Group C heaters (if needed), borings will be located within the 10-foot wide access corridor located within the Former Molding Room Area. Each post-remediation soil boring depicted on Figure D-4 will be installed vertically (90° angle from horizontal) and drilled to the base of the target treatment zone (TTZ) (approximately 120 feet bgs) or until competent bedrock is reached, whichever is shallowest.

3.2.2 Soil Sampling Means and Methods

Prior to conducting intrusive activities, utility mark-outs will be coordinated through the New Jersey One Call System and Ramboll will coordinate utility identification and clearance activities with Albéa. To identify subsurface utilities and confirm their location prior to initiating any intrusive work, Ramboll will complete geophysical surveys (e.g., using ground-penetrating radar and electromagnetic conductivity) of the areas where intrusive activities will occur (i.e., soil boring installation, underground work).

Upon completion of the geophysical utility clearance efforts, all soil boring locations will be cored through the concrete with a wet rotary diamond coring method to control dust particulates. The cores will be advanced through the concrete floor and be left in place until the locations are ready to be advanced as soil borings. An air knife or hand clearing will be used to clear the upper approximately 5 feet of each boring prior initiation of sonic drilling. Advancement of soil borings will be completed through the use of sonic drilling methods using a 4-inch core barrel and 6-inch override casing. In this configuration, a 5-foot soil core barrel (4-inch diameter) is advanced to collect the soil core and is then overridden with the 6-inch casing. Once the casing is overridden, the soil core is removed and provided to the field geologist for logging and soil sampling. The soil core barrel will be advanced without the use of a drilling fluid to limit impact to soil sample collection. If denser units are encountered (i.e., rock or boulders) several mitigation measures to reduce the impact on analytical samples from the drilling process will be performed. These include shorter sampling intervals and specialized drive buffers that limit heat

generation. The override casing will be advanced using a minimal amount of water. This is necessary to clear the annular space between the 4- and 6-inch casing and to reduce friction. All fluids will be contained and disposed in appropriate containers (55-gallon drums and/or roll-off containers) for disposal in accordance with the Waste Management Plan contained in Appendix G in the Final (100%) Remedial Design Report.

After soil boring activities are complete, a Professional Land Surveyor registered and licensed in New Jersey will survey the soil boring locations. The horizontal location and vertical elevation of each boring will be surveyed utilizing the current State Plane Coordinate System (North American Datum of 1983) and vertical elevation datum (NGVD 88).

3.2.3 Soil Sample Collection Procedure

Due to the elevated soil temperatures resulting from the TCH operations, soil borings completed for post-treatment soil verification sampling will follow the hot soil sampling procedure presented in Attachment 1. Soil samples from the TTZ will be continuously logged for classification, soil characteristics (e.g., texture, color), and screened using a 10.6 electron volt (eV) photoionization detector (PID) to evaluate the concentration of total organic vapors present. Downhole tooling and soil extracted at depth must be handled appropriately with temperature rated personal protective equipment (PPE). Soil samples collected via roto-sonic are typically brought to the surface and extracted into polyethene sleeves. Prior to soil extraction into polyethene sleeves, the polyethene sleeve will be tested against the steel core-barrel to verify temperature tolerance. If polyethene sleeves are not tolerant of the soil temperatures, a split core barrel or aluminium liner will be used.

Once the soil has been extracted from the core sample barrel, the soil sample contained in a plastic sleeve, split core barrel, or aluminium liner will be sealed at both ends and placed in an ice bath to reduce the soil temperature. To reduce the loss of VOCs, soil samples will be in the ice bath no longer than 3 hours.

When the soil sample has reached approximately 50 degrees Fahrenheit (°F) (10 degrees Celsius [°C]), or the sample has been chilled for 3 hours, the soil will be inspected, logged by a geologist to include a description of the soils using the Unified Soil Classification System (USCS), and screened for VOCs with a PID equipped with a 10.6 eV lamp. Soil characteristics, lithologies, and PID readings will be recorded on soil boring logs or a bound field book in accordance with the SOP included in the QAPP.

Based on recovery, a minimum of two soil samples will be collected from each 5-foot core run. Sampling will begin just above the top of the TTZ at a depth of 65 feet bgs at each of the three potential post-remediation soil boring locations. Once initiated, sampling will continue through the unconsolidated zone to the base of the TTZ at approximately 120 feet bgs or until the top of competent rock is encountered, whichever is shallowest. The samples selected for chemical analysis will be chosen based on the PID field screening readings and/or the presence of visual or olfactory indications of impact. Each soil sample will be collected for chemical analysis using a Terra Core sampler and Method 5035 preservation in accordance with the soil sampling SOPs as described in the QAPP. Soil sample identification will follow a standard convention and is discussed in Section 4.

3.3 Sub-Slab and Indoor Air Sampling

After verification that the RG has been attained for soils and the USEPA has approved ISTR system shutdown, the vapor intrusion mitigation systems (SSDS) for the VIRA inside the ANC building will be shut down. After approximately 1 to 2 weeks following shut-down, one round of sub-slab vapor and indoor air samples will be collected to determine if the VIRA activities can be discontinued or if vapors are still present above levels that warrant continued operation of the vapor mitigation system and/or further

monitoring of sub-slab vapor or indoor air. Indoor air samples will be collected at the following seven locations in accordance with the *Operation, Maintenance, and Monitoring Plan for Vapor Intrusion Response Activities* (Ramboll Environ, 2017).

- Former Molding Area (ISTR-IA01 [formerly CDM-IA-01]);
- EHS Manager's Office (ISTR-IA02 [formerly CDM-IA-04 and EPA-IA-27]);
- S. Central Cafeteria (ISTR-IA03 [formerly CDM-IA-07]);
- EHS Coordinator's Office (ISTR-IA04 [formerly CDM-IA-08]);
- 2nd Floor Sales Office (ISTR-IA05 [formerly EPA-IA-16]);
- MPA between VP-14 and VP-15 (ISTR-IA06 [formerly EPA-IA-18]); and
- 2nd Floor Conference Room (ISTR-IA07 [formerly EPA-IA-23]).

In addition, ten sub-slab vapor samples will be collected from the existing sub-slab vapor monitoring points.

- CDM-SS-01;
- CDM-SS-02;
- CDM-SS-03;
- EPA-SS-22;
- EPA-SS-30;
- EPA-SS-31;
- EPA-SS-32;
- VP-3;
- VP-7; and
- VP-15.

The locations of these indoor areas and sub-slab vapor monitoring points are shown on Figure D-5. The samples will be collected and analyzed for VOC using USEPA Method TO-15 in accordance with the QAPP. Indoor air and sub-slab vapor samples will be compared to site specific regulatory criteria as described in the ROD.

Indoor air and sub-slab vapor sample identification will follow a standard convention and is discussed in Section 4.

3.4 Laboratory Analyses

Soil

Soil samples will be shipped to one of the following laboratories (preferred laboratory listed first):

TestAmerica Laboratories, Inc.
777 New Durham Road
Edison, NJ 08817
(732) 549-3900

Integrated Analytical Laboratories (IAL), LLC
273 Franklin Road
Randolph, NJ 07869
(973) 361-4252

Air

Air samples will be shipped to one of the following laboratories (preferred laboratory listed first):

SGS EHS USA (Formerly Accutest Inc)
2235 US Highway 130
Dayton, NJ 08810
(732) 329-0200

TestAmerica Laboratories, Inc.
30 South Community Drive
Burlington, VT 05403
(802) 660-1990

Integrated Analytical Laboratories (IAL), LLC
273 Franklin Road
Randolph, NJ 07869
(973) 361-4252

The laboratory will perform analyses as requested on the chain of custody (Section 6). The laboratory QA plan and relevant SOPs are included in Appendices B through E of the QAPP. Air and soil samples will be analyzed for VOCs using various USEPA Methods (TO-15 for air and 8260C for water and soil).

Samples for waste disposal purposes will require additional analyses. The specific analytical requirements are provided in Table 4A in the QAPP. Additional analytical requirements could be required by the selected disposal facility and will be collected in combination with the analytical requirements in Table 4A of the QAPP and Waste Management Plan (Appendix E of the RDWP).

4. SAMPLE IDENTIFICATION

The designation or identifier for each sample is used to uniquely identify each type of sample collected at the PVGCS Site. All samples from all sample media will be assigned a unique alpha-numeric sample descriptor identifying the project site (POH). Air samples will include the sample port or location and a six-digit numeric code indicating the date of sample collection (yymmdd). Soil samples collected from soil borings will include the soil boring location and depth interval.

Matrix codes for samples that will be collected include the following:

Project Site Description

- POH – for Pohatcong Valley Groundwater Contamination Superfund Project Site.

Soil Sample Descriptions

- PTSB – for post-treatment soil boring sample locations.
- SB – for soil boring location name.
- WS – for waste soil/sediment samples (characterization for off-site disposal), if collected.

Air Sample Descriptions

- VP-## or [EPA/CDM]-SS-## – for the post-treatment sub-slab vapor sample designation at an existing sub-slab sampling location.

Quality Control Sample Descriptions

- FD – for field duplicate samples
- EB – for field equipment blanks
- TB – for trip blanks (VOCs only)

4.1 Example Soil Sample Designations

The soil sampling program includes the collection and analysis of samples from up to six locations identified on Figure D-4. Soil samples will be collected throughout the TTZ (65 to 120 feet bgs in the Former Molding Room Area and MPA). Soil samples will be designated as:

- POH-PTSB-SB##(XX-XX)

Where ## is the soil boring number (01 through 06), and XX specifies the depth in feet using two digits. For example:

- POH-PTSB-SB01(70-72) will be used for the soil sample collected from soil boring location SB01 from the 70 to 72-foot bgs interval.

4.2 Example Air Sample Designations

The air sampling program includes the collection and analysis of samples from seven indoor air locations and 10 sub-slab vacuum monitoring point (VMP) locations identified on Figure D-5 for chlorinated VOCs using USEPA Method TO-15. Air samples are separated into three categories: indoor air, sub-slab vapor, and vapor mitigation system air samples. These categories are described below.

4.2.1 Indoor Air Sample Designations

Indoor air samples will be designated using the following descriptor:

- POH-ISTR-IA##-[yymmdd]

Where ## is the numbered location of the indoor air sample. Each location has been identified and designated a unique name and shown on Figure D-5. The [yymmdd] is the year, month, and day the sample is collected. For example:

- POH-ISTR-IA01-181231 would be used for the indoor air sample collected from the former molding area (former indoor air sample location CDM-IA-01) on December 31, 2018.

4.2.2 Sub-Slab Vapor Sample Designations

Sub-slab vapor samples will be designated using the following descriptor:

- POH-SS-[VP-##]/[EPA/CDM-SS-##]-[yymmdd]

Where VP-## or EPA/CDM-SS-## is the sub-slab vapor location and [yymmdd] is the year, month, and day the sample is collected. Each location has been identified and designated a unique name and shown on Figure D-5. A sample identification example is presented below:

- POH-SS-VP-14-190215 would be used for the sub-slab vapor sample collected from the vapor monitoring point VP-14 on February 15, 2019.
- POH-SS-EPA-SS-31-190215 would be used for the sub-slab vapor sample collected from the vapor monitoring point EPA-SS-31 on February 15, 2019.
- POH-SS-CDM-SS-02-190215 would be used for the sub-slab vapor sample collected from the vapor monitoring point CDM-SS-02 on February 15, 2019.

4.3 Example Quality Control Sample Designations

Field duplicate (FD), equipment blank (EB), and trip blank (TB) QC samples will use the appropriate code for the sample matrix and/or type of QC sample. Equipment and trip blank samples will be numbered with the date. Field duplicate samples will have the QC code appended to the end of the sample ID. Example IDs for the types of QC samples are as follows:

- EB-01-190211 – indicates the first or only equipment blank collected on February 11, 2019 (190211).
- TB-02-190301 – indicates the second trip blank associated with soil or groundwater samples that were collected on March 1, 2019 (190301).
- POH-PTSB-SB04(120-121)FD – indicates a field duplicate from the post-remediation performance soil boring SB04 collected from the 120 to 121 feet bgs interval.

4.4 Example Waste Characterization Sample Designations

Waste characterization samples will be collected from soil generated during confirmation soil boring activities. Waste characterization samples will be designated as:

- POH-WS-##-[yymmdd]

Where ## is the sequentially numbered sample (if more than one waste stream is generated) and [yymmdd] is the year, month, and day of sample collection.

5. FIELD PROCEDURES

Field personnel will understand the requirements of this FSP and will be trained in the use of the specified equipment and techniques. The Site Supervisor is responsible for reviewing the day-to-day activities to ensure that the procedures in this FSP are followed. Specific activities that will be implemented by the Site Supervisor include the following:

- A meeting of field personnel will be conducted at the start of a specific sampling event to review the sampling requirements of the FSP; the appropriate equipment and its use; decontamination procedures; and required documentation. This meeting is especially important prior to conducting soil boring work in the thermal treatment zone.
- Review documentation for completeness, errors, problems, and corrective actions taken.
- Convene project team meetings, as needed, to address questions identified during the previous day's work and review the work to be completed that day.

5.1 Field Measurements

The equipment used for in-field measurement will be maintained, calibrated, and used in the field according to the manufacturer's specification. Significant deviations from the FSP, errors, equipment failures, or other problems will be recorded in a bound notebook by the field team and reported to the

Project Manager. The field crew using the sampling equipment is required to understand the proper use of the equipment and how to clean and maintain the equipment in proper working order. Field staff will note issues that may affect the quality of the sample collection efforts. Corrective actions, if required, will be coordinated with the project team by the Site Supervisor. Personnel involved in the collection of samples are required to read, understand, and follow the procedures specified in this FSP and in the QAPP.

5.2 Quality Control

QA/QC procedures will be implemented to ensure that data that are used for remediation decisions are of known quality and usable for this purpose. A more complete description of QA/QC procedures, including those implemented by the laboratory are provided in the site-specific QAPP submitted under separate cover. QC procedures include the use of standardized methods (SOPs) for sampling and analysis and documenting the use of those methods so that the data generated are traceable and of known quality. Measures of field and laboratory bias (accuracy) and precision are determined by the collection of QC samples. The results are used in the data review/validation process to provide measures of data quality. QC samples that may be collected during this program are described below.

5.2.1 Field and Laboratory Duplicates

Field and laboratory duplicates are used to evaluate individual sample, sampling, and laboratory variability. Field duplicates will be collected for discrete samples by filling two sample containers (including air or vapor samples). Field duplicate samples will be prepared following compositing by dividing the composited sample into two separate containers. Field duplicate samples will be collected at a frequency of 5% (1 in 20 samples).

5.2.2 Split Samples

As an additional measure of QC, the USEPA may request that split samples be sent to a laboratory of USEPA's choosing. Split samples will be collected in the same manner as field duplicates and will be labeled using the same sample ID as the parent sample with a split sample code (i.e., SP) appended to the end of the sample. Split samples will be given to USEPA's designee and noted in the field book.

5.2.3 Equipment Blanks

Field equipment blanks will be collected and submitted to the analytical laboratory to assess the effectiveness of decontamination procedures. Field equipment blanks will be collected following decontamination of the non-dedicated sampling equipment. Blanks are collected by pouring analyte free water over the decontaminated equipment and into a sample container. Field equipment blanks will not be collected for disposable or dedicated sampling equipment. Field equipment blanks will be collected at a frequency of once per day or once per 20 (individual grab) sample locations, whichever is less frequent. If disposable equipment is used, a single equipment blank will be prepared using that disposable equipment at the beginning of the program. Equipment blanks will not be collected for air or vapor samples.

5.2.4 Trip Blanks

If samples are collected for VOC analysis (or Toxicity Characteristic Leaching Procedure [TCLP]), a trip blank will be included in each cooler containing VOC samples. Trip blanks are used to provide a measure of the amount of cross contamination, if any, that occurs during cooler storage and transport to the laboratory. A trip blank consists of analyte-free water sealed in a VOC sample container. The trip blank accompanies empty containers to the field and field samples when they are shipped to the laboratory. A trip blank will not accompany air or vapor samples.

5.2.5 Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

MS/MSD samples (duplicate and spike for inorganic analyses) are laboratory QC samples that provide information about the effect of the sample matrix on the analytical results. MS/MSD samples will be analyzed in accordance with the laboratory operating procedures provided in the laboratory QA Plan (Appendix B to the QAPP). For soil and groundwater samples, the MS/MSD samples should be designated on the chain of custody at a frequency of 5% (1 in 20). A MS/MSD will not be collected for air or vapor samples.

5.3 Decontamination Procedures

Decontamination of sampling equipment is performed to reduce the possibility of cross-contamination of samples. Disposable or dedicated equipment does not require decontamination. Equipment used to handle samples will be decontaminated and may include, but will not be limited to, the following:

- down-hole drilling equipment and down-hole drilling equipment tooling;
- soil logging equipment including stainless steel spatulas and table-top; and
- electrical or mechanical mixing equipment for waste characterization composite sample preparation, if necessary.

Decontamination procedures are described in Ramboll SOP S-05 (Appendix A to the QAPP). Field blanks will be collected to measure the effectiveness of decontamination procedures as described in the QAPP and Section 5.2.3 of this FSP.

6. SAMPLE RECORDKEEPING AND HANDLING PROCEDURES

Documentation of sample collection will include photographs, field notes, sample labels, and chain of custody. Hard bound field notebooks will be used by the field team. Daily field activities will be recorded in the field notebooks. Sample collection notebooks will contain sample and collection notes. In some cases, field log sheets may be used to record data in consistent formats. Field notes will be recorded in accordance with Ramboll SOP RK-03 (Appendix A to the QAPP).

The sampler is responsible for sample custody from the time of sample collection to shipment to the laboratory. Chain of custody procedures are discussed in detail in Ramboll SOP RK-02 (Appendix A to the QAPP) and the QAPP. Sample containers, preservation methods, and holding times for samples for chemical analysis are provided in the QAPP. Samples will be packaged and shipped in accordance with Ramboll SOP FLD-03, SOP FLD-04, SOP FLD-05, SOP FLD-07, and SOP FLD-08 (Appendix A to the QAPP). Field book or other (e.g., data sheets or electronic) records will include:

- date;
- field staff present, visitors, and other observations;
- activities conducted;
- sample location information (matrix, sampling coordinates);
- samples collected and methods;
- samples shipped and relevant carrier and air bill information; and
- photographs taken.

Records will be maintained in the permanent project file and will be used in conjunction with laboratory data to report the investigation findings.

Analytical reports will be provided as full Level 4, fully validated data packages. In addition, laboratories will provide electronic data deliverables (EDDs) in Environmental Quality Information System (EQuIS) and Microsoft Excel formats for submission to the USEPA.

7. MANAGEMENT OF WASTE MATERIALS

Soil in excess of the required sample volume will be containerized for off-site disposal. Used PPE and other types of general debris or waste materials produced during the fieldwork will be collected in plastic garbage bags and disposed of as solid waste. A Waste Management Plan is provided as Appendix E of the RAWP.

8. REFERENCES

Consent Decree. 2015. United States of America v. Pechiney Plastics Packaging, Inc. (Civil Action No. 09-cv-05692) and United States of America v. Bristol Myers Squibb Company, et. Al. (Civil Action No. 13-cv-05798), effective March 11.

Ramboll Environ. 2015. Operation, Maintenance, and Monitoring Plan Vapor Intrusion Response Activities Albéa America, Washington Facility 191 Route 31 North Washington, Warren County, New Jersey. October.

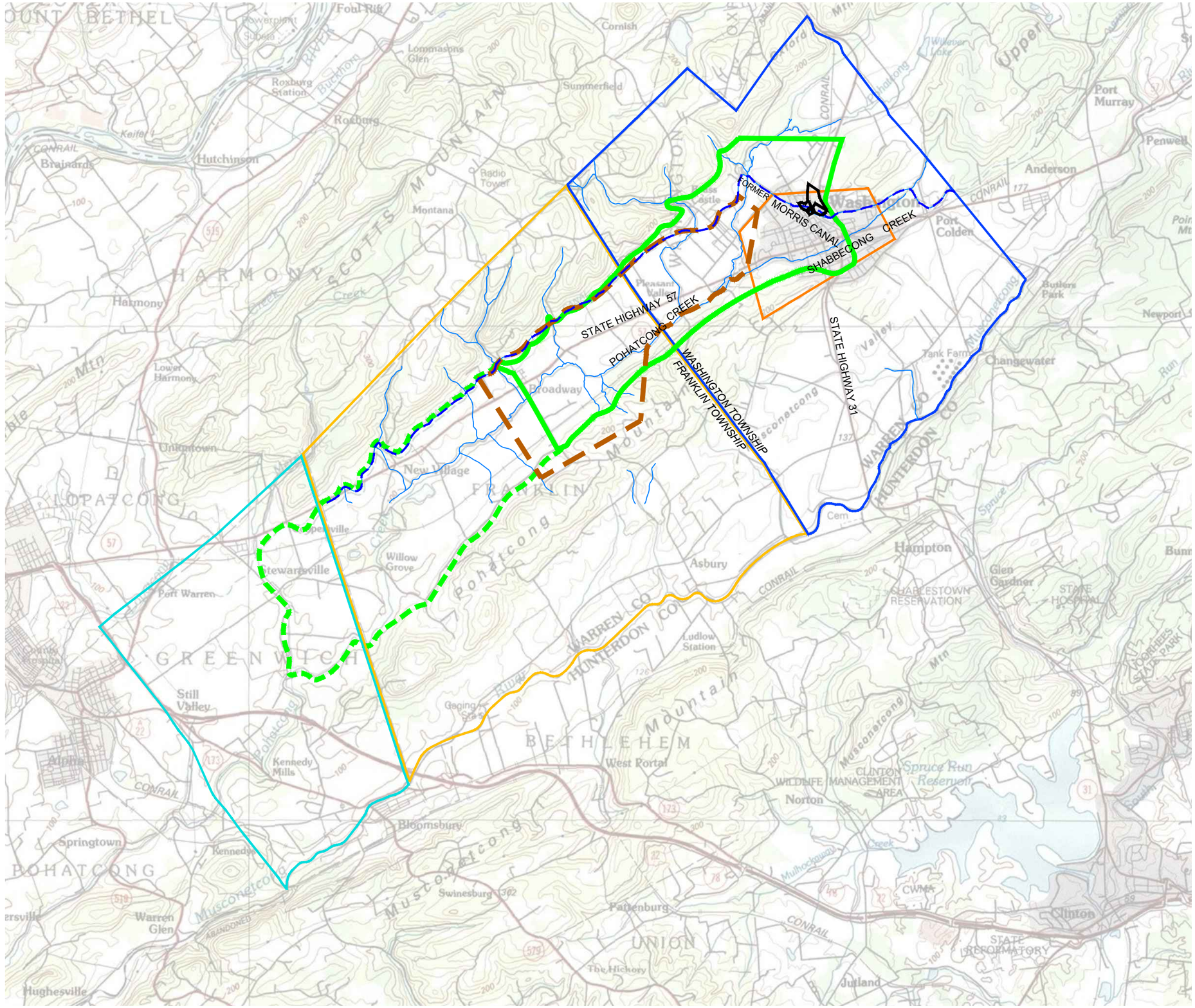
Ramboll US Corporation. 2018a. Quality Assurance Project Plan (Revision 9), OU1 (TCE Groundwater), OU2, OU3, and Vapor Intrusion Removal Action, Pohatcong Valley Groundwater Contamination Superfund Site, Warren County, New Jersey. February.

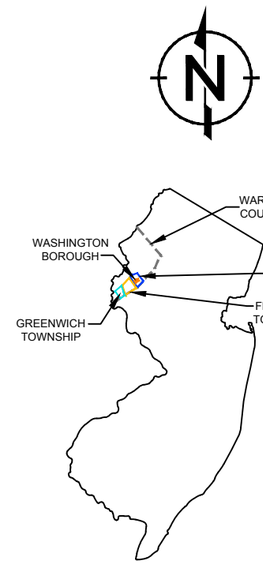
Ramboll US Corporation. 2018b. Remedial Design Work Plan, Operable Unit 3 (OU3), Pohatcong Valley Groundwater Contamination Site (PVGCS), Warren County, New Jersey. April.

USEPA. 2016a. Record of Decision, Pohatcong Valley Groundwater Contamination Superfund Site Operable Unit 3, Washington Borough and Washington Township, Warren County, New Jersey. September.

USEPA. 2017. Statement of Work for Implementation of the Operable Unit 3 (OU3) Remedial Design and Remedial Action, pursuant to the Consent Decree entered in United States v. Pechiney Plastics Packaging, Inc., (PPPI), 09-cv-5692 and United States v. Bristol Myers Squibb Co., et al., 13-cv-5798. June.

FIGURES





LEGEND

- NJDEP WELL RESTRICTION AREA (WRA)
- OU3 BOUNDARY
- USEPA POHATCONG OU1 STUDY AREA
- APPROXIMATE USEPA POHATCONG OU2 STUDY AREA
- FORMER MORRIS CANAL
- WATERWAYS
- GREENWICH TOWNSHIP
- FRANKLIN TOWNSHIP
- WASHINGTON BOROUGH
- WASHINGTON TOWNSHIP

SOURCES:
"FIG 1, LOCATION OF OU1/OU2 STUDY AREAS" CH2MHILL, OU2 REMEDIAL INVESTIGATION. USGS 100K MAP SERIES FROM TOPO!

0 6,500
SCALE IN FEET

LOCATION OF POHATCONG VALLEY GROUNDWATER CONTAMINATION SITE

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL ENVIRON

FIGURE D1

DRAFTED BY: ELS	DATE: 2/13/19	1690008019

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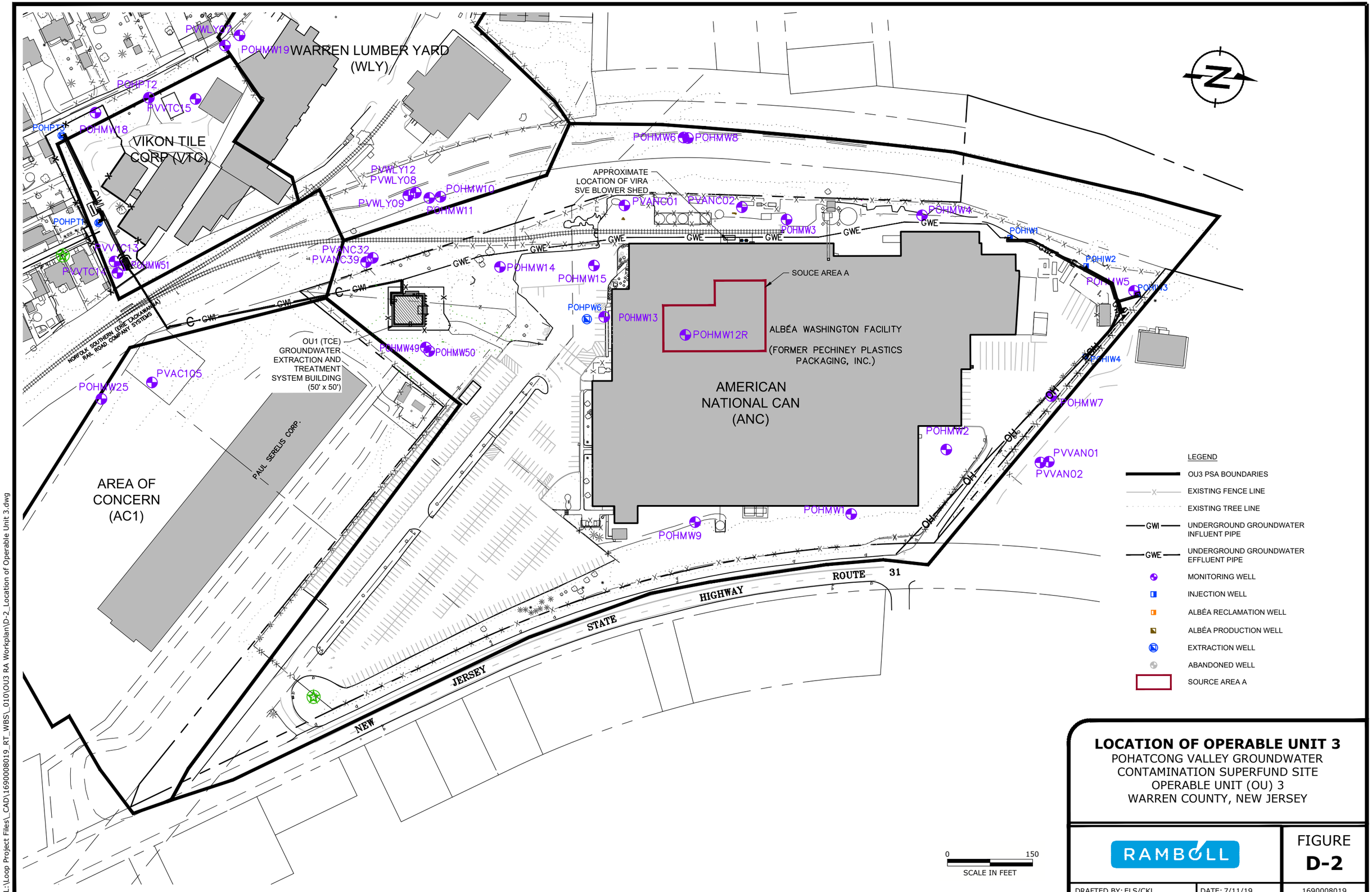


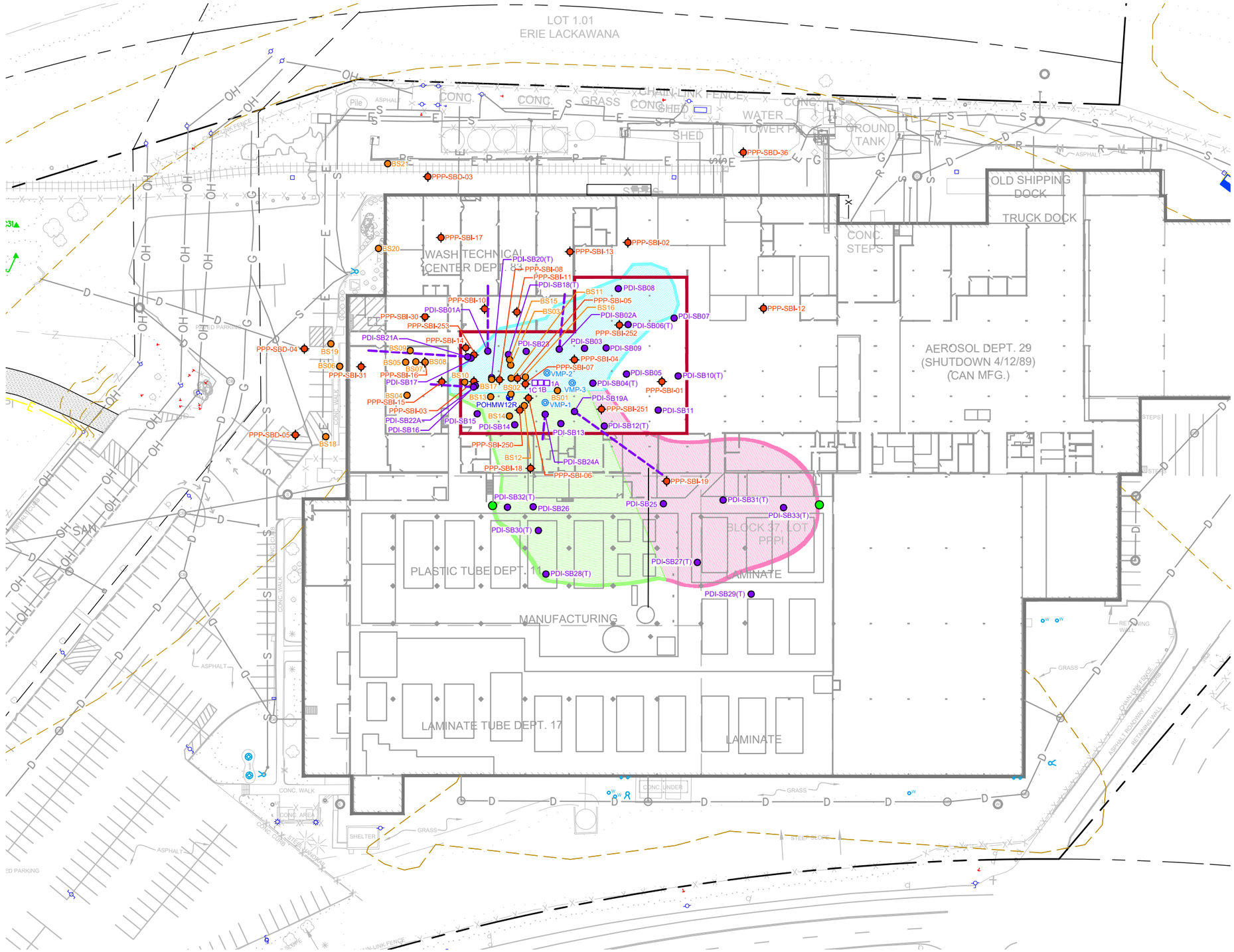
LOCATION OF OPERABLE UNIT 3
POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL

FIGURE
D-2

DRAFTED BY: ELS/CKL | DATE: 7/11/19 | 1690008019

L:\Loop Project Files_CAD\1690008019_RT_WBS_010\OU3 RA Workplan\D-2_Location of Operable Unit 3.dwg



LEGEND:

- POTENTIAL SOIL BORING LOCATION DURING ISTR SYSTEM INSTALLATION
- MONITORING WELL
- ANGLED SOIL BORING
- SOIL BORING
- SOIL BORING (REMEDIAL INVESTIGATION)
- SOIL BORING (EPA)
- VAPOR MONITORING PROBE
- SVE PILOT TEST WELL
- (T) ISTR THERMOCOUPLE LOCATION
- BUILDING COLUMN
- FORMER MOLDING ROOM
- EXTENT OF TCE SOIL IMPACT (GROUP A)
- EXTENT OF TCE SOIL IMPACT (GROUP B)
- EXTENT OF TCE SOIL IMPACT (GROUP C)
- E ELECTRIC LINE
- G GAS LINE
- S WATER LINE
- D STORM LINE

0 80
SCALE IN FEET

POTENTIAL SOIL SAMPLING LOCATIONS

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL

FIGURE
D-3

DRAFTED BY: ELS | DATE: 11/8/19 | 1690014983

L:\Loop Project Files_CAD\1690014983_ISTR System Design Mods-Updates to RAWP_003\D-3_Potential Soil Sampling Locations.dwg

LEGEND:

- MONITORING WELL
- ISTR HEATER (VERTICAL)
- ISTR HEATER (ANGLED)
- ISTR HEATER CLUSTER (ANGLED)
- TEMPERATURE MONITORING POINT
- POTENTIAL POST-REMEDIATION SOIL BORING (DRAFT LOCATION- TO BE CONFIRMED IN THE FIELD)
- SVE/SSDS EXTRACTION POINT
- WEST WALL SUB SLAB DEPRESSURIZATION EXTRACTION POINT (STANDBY SSDS POINT)
- EAST WALL SUB SLAB DEPRESSURIZATION EXTRACTION POINT
- VAPOR MONITORING PROBE
- BUILDING COLUMN
- FORMER MOLDING ROOM
- EXTENT OF TCE SOIL IMPACT (GROUP A)
- EXTENT OF TCE SOIL IMPACT (GROUP B)
- EXTENT OF TCE SOIL IMPACT (GROUP C)

NOTE:
POTENTIAL POST-REMEDIATION PERFORMANCE SOIL BORING LOCATIONS MAY VARY DEPENDING ON FINAL CONFIGURATION OF ISTR HEATER WELL LOCATIONS.

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SCALE IN FEET

POTENTIAL POST-REMEDIATION PERFORMANCE SOIL BORING LOCATIONS

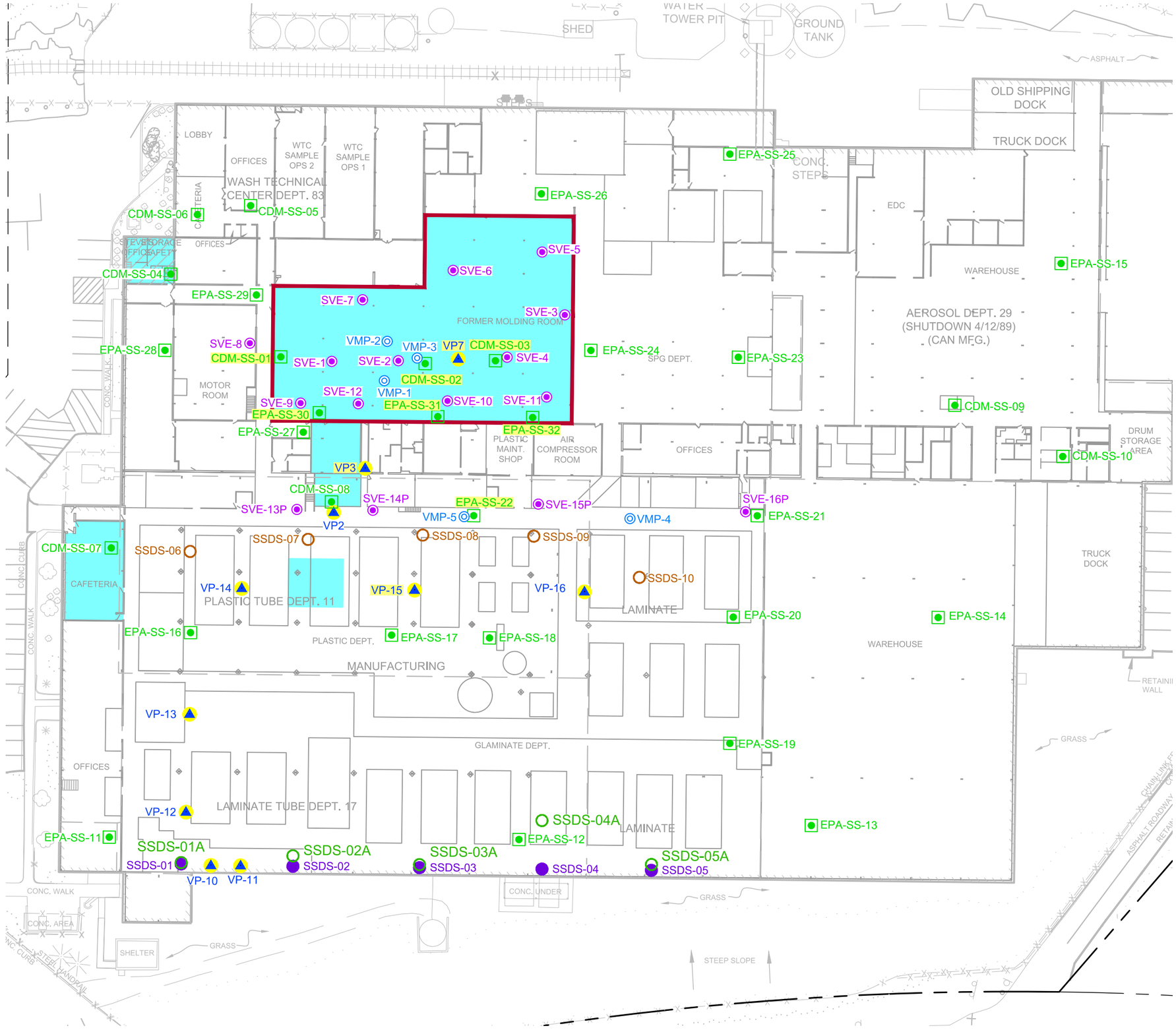
POHATCONG VALLEY GROUNDWATER CONTAMINATION
SUPERFUND SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL

FIGURE **D-4**

DRAFTED BY: ELS	DATE: 12/3/19	1690014983

L:\Loop Project Files_CAD\1690014983_ISTR System Design Mods-Updates to RAWP_003\D-4_Potential Post-Remediation Performance SB Locations.dwg



LEGEND

- SOURCE AREA
- EPA-SS — SUB SLAB VAPOR MONITORING POINT (INSTALLED BY OTHERS)
- VP — SUB SLAB VAPOR MONITORING POINT (INSTALLED BY ENVIRON)
- SVE — SVE/SSDS EXTRACTION POINT
- SSDS — WEST WALL SUB SLAB DEPRESSURIZATION EXTRACTION POINT (STANDBY SSDS POINT)
- SSDS — EAST WALL SUB SLAB DEPRESSURIZATION EXTRACTION POINT
- VAPOR MONITORING PROBE
- POST-ISTR OPERATION INDOOR AIR SAMPLE LOCATION
- VP7 — POST-ISTR OPERATION SUB-SLAB VAPOR SAMPLE LOCATION

0 60
SCALE IN FEET

POST-ISTR OPERATION INDOOR AIR AND SUB SLAB VAPOR SAMPLING LOCATIONS

POHATCONG VALLEY GROUNDWATER CONTAMINATION SITE
OPERABLE UNIT (OU) 3
WARREN COUNTY, NEW JERSEY

RAMBOLL

FIGURE **D-5**

DRAFTED BY: ELS	DATE: 11/8/19	1690014983

L:\Loop Project Files_CAD\1690014983_ISTR System Design Mods-Updates to RAWP_003\D-5_Post-ISTR Operation IA and Sub-Slab VS Locations.dwg

ATTACHMENT 1

ISTR SPECIFIC STANDARD OPERATING GUIDELINES AND PROCEDURES

TRS Accelerating Value	STANDARD OPERATING PROCEDURE	PROCEDURE No: 3.2

Procedure Title:

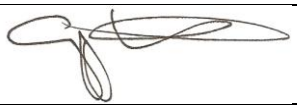
HOT SOIL SAMPLING

Author:	TRS Team	Issue Date:	4/22/08

Revisions:

Date	Initials	Revision Description	Revision #
01-04-10	LS	Add Scope, responsibilities, training, definitions, recordkeeping	1
5-6-14	TP	Added caution concerning hot water, steam expulsion	2
2-22-16	TP	Review, revised power off requirement	3
12-4-17	GK	Removed Geoprobe® Dual-Tube Sampler reference and revised determination for use of Teflon liners.	4
12-02-19	GK	Added section on hot sampling with sonic drill rig	5

Reviewed and Approved by (initial and date):

SOP/ Revision #	Safety & Quality		Engineering	
Original	4/22/08		4/22/08	
REV 1	1/4/10		1/4/10	
REV 2	5/6/14		5/6/14	
REV 3	2/24/16		2/22/16	
REV 4	12/4/17		12/6/17	
REV 5		12/2/2019		12/2/2019

TRS Accelerating Value

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a procedure for the safe collection of representative soil samples during, or after, the application of *in situ* thermal remediation (ISTR) technologies.

2.0 SCOPE

This SOP serves as a guideline for the collection of soil samples during, or after, the application of ISTR. To minimize the risk due to electrical hazards, lockout/tagout (LOTO) procedures must be applied to the ISTR power control unit (PCU) throughout the duration of the soil sampling effort. Only authorized persons trained in procedures and requirements described in SOP 1.1 are permitted to conduct LOTO on TRS equipment. Samples collected using this SOP are generally used for evaluating treatment effectiveness, and/or confirming treatment goals have been met.

TRS Group, Inc. (TRS) personnel shall use this procedure in conjunction with site-specific sample analysis plans and permit requirements. These are standard (i.e., typically applicable) operating procedures, which may be varied or changed as required, dependent on site conditions, equipment limitations, permit requirements, or limitations imposed by the procedure. The ultimate procedures, including any deviations from this SOP, shall be documented in the soil sampling form.

3.0 DEFINITIONS

Authorized Employee

Any designated employee who locks out or tags out equipment to perform servicing or maintenance. This person must have completed the mandatory LOTO training described in SOP 1.1 LOTO to be qualified as an authorized worker. Only an authorized worker installs and removes his or her own lock and tag as required by this program.

Competent Person

Any designated employee who has been trained in proper procedures for the application of ISTR to the subsurface at remediation sites.

ISTR – In Situ Thermal Remediation

A process whereby soil and groundwater are heated to the desired temperature to volatilize the target contaminants. Some ISTR technologies are electrical resistance heating (ERH), thermal conduction heating (TCH), and steam enhanced extraction (SEE).

LOTO – Lockout/Tagout

The practice of using a tag for visibility and awareness in conjunction with placement of a keyed device ("lock") on an energy isolating device, in accordance with SOP 1.1, to prevent the unwanted activation of mechanical or electrical equipment. Lockout ensures the equipment being controlled cannot be operated until the lock is removed.

4.0 EQUIPMENT LIST

1) Soil Sampling Field Form and pen (recommend indelible).
2) Drill rig and related equipment. Soil sampling is best achieved using a direct push drill rig such as a Geoprobe®. Alternative types of drilling methods are hollow stem auger (HSA) or rotosonic (sonic).

3) Ice bath for soil samples. An example is a cooler filled with ice. The cooler (or container) must be equipped with an opening at the bottom to allow water from melting ice to drain.

4) Standard cooking thermometer. Calibrated to both zero (0) degrees Celsius (°C) and 100°C (an infrared thermometer can be substituted when sampling denser soils or bedrock. Keep in mind the sample tube will likely be a few degrees cooler than the internal temperature of the sample).
5) LOTO equipment as described in TRS SOP 1.1.
6) Sample containers, labels, and chain-of-custody forms (as required by the laboratory for the analysis).
7) Safety Glasses with side shields. Additional option: full face-shield (wear over safety glasses).
8) Hearing protection adequate for sampling equipment decibel level. Refer to site-specific Health and Safety Plan (HASP).
9) Latex or nitrile gloves. Additional option: cotton or leather outer gloves (wear over inner latex gloves).
10) Site-specific personal protective equipment (PPE) requirements. Refer to site-specific HASP.
11) Packaging material, chain-of-custody seals, and shipping labels.

5.0 HOT SOIL SAMPLING PROCEDURES

A soil-sampling event begins with the shutdown and application of LOTO to the PCU. This is done to prevent any electrical hazards between the steel drill string and sampling personnel. The vapor recovery system should continue to operate to maintain capture of steam in the subsurface, rather than allowing it to exit through the sample borehole. Interim and final soil sampling is best achieved using a direct push drill rig such as a Geoprobe®. As the probe casing is extracted from the subsurface, it should be considered to be very hot, and handled with proper precaution and personal protective equipment.

Choose a sample sleeve compatible with the conditions being encountered. For example, if the sample location temperature is elevated above 100°C, then a stainless steel sleeve will be a better choice than a Teflon sleeve as the Teflon sleeve will become soft and deform at elevated temperatures. Consult engineering for the appropriate sleeve. Teflon sleeves are only recommended for sampling when expected subsurface temperatures will be at or below 70°C.

Note: sample sleeves can be custom fabricated if supplier inventories are inadequate. Please contact equipment@thermalrs.com if additional resources are needed to procure sampling sleeves.

5.1 Safety Considerations

There are certain hazards associated with the application of ISTR to contaminated soil and groundwater. These hazards include possible contact with hazardous voltages, steam, hot water, hot soil, other hot surfaces, and/or hazardous chemicals. Exposure to these hazards can be mitigated through engineering controls and strict adherence to documented procedures and safety protocols such as the following restrictions:

- The ISTR PCU system must be turned off and LOTO applied during soil sampling activities. Only trained and authorized TRS personnel can perform LOTO of ISTR equipment.
- High temperatures, hot water, and steam may be encountered when collecting subsurface soil samples; the use of the proper PPE is mandatory and caution is advised.
- Contaminant vapors may be present at the borehole during sampling.
- Personnel shall be trained on hazards and engineering controls associated with drilling before beginning sampling operations. Potential hazards include rotating equipment, overhead loads, and slips trips and falls.

Refer to the site-specific Sampling and Analysis Plan (SAP) and HASP for site-specific requirements and restrictions.

Caution: Exposure to hot groundwater and steam possible

The removal of water and soil from the sample borehole can change the temperature/pressure equilibrium conditions existing within the borehole prior to drilling and sampling by reducing the hydrostatic head in the borehole, allowing hot water and steam to eject from the borehole. Review the site conditions prior to commencing drilling or boring. If sampling soil beneath the groundwater surface level elevation, always remove the boring equipment and samples slowly from the boring to allow the borehole conditions to safely re-equilibrate.

Stop and complete the attached Site Sampling Evaluation Checklist before proceeding with this procedure.

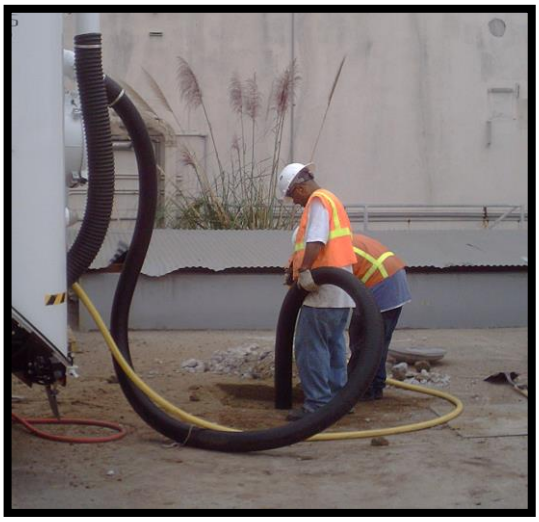
5.2 Hot Soil Sampling Procedures

Whenever possible, sampling shall be completed in order from sample locations having the lowest anticipated concentrations of contaminants of concern (COCs) to locations having the highest anticipated COC concentrations (i.e.; outside treatment area, treatment area boundary, locations within the source area). The steps outlined below must be followed for iterative, interim, and/or final hot soil sampling.

Contact the TRS Project Manager (PM) the day prior to sampling to coordinate a shutdown. A shutdown period of 4 hours is preferred prior to soil sampling.

1) An authorized person shall apply LOTO to the ISTR PCU by site-specific instructions. Note: Only personnel who have been trained and certified by TRS in LOTO procedures can complete this procedure.
2) Position drill rig in the area to be sampled and perform a visual check for any safety concerns. Potential concerns include: high voltage lines, uneven terrain, underground utilities, and egress limitations with rig placement.

3) Hand auger or air knife the first five (5) feet of the boring to clear the location for potential buried utilities.



4) Advance the push sampler to the depth required and collect samples. If subsurface temperatures are expected to be greater than 70°C, the sample sleeves used must be made of brass or stainless steel. Sample sleeves made of acrylic or other materials can melt and bias sample results.

5) The sample sleeves must be capped immediately and placed into the ice bath to begin the cool-down process. Water from melting ice must be allowed to drain, as the sample sleeves should not be submerged at any time.

6) The sample sleeves should be cooled until the soil nears ambient temperature (approximately 20°C or 70 degrees Fahrenheit [°F]). A standard cooking thermometer can be inserted through the end cap for temperature monitoring. The sample sleeve may be opened and sampled once near-ambient temperatures have been reached. Soil samples, including quality control (QC) samples, are collected, labeled, preserved, and shipped per the site-specific SAP.
7) Plugging/sealing of the soil borehole will be in accordance with Federal, State, and/or Local regulatory and client requirements.
8) Soil cuttings not consumed in the sampling process will be disposed of according to Federal, State, and/or Local regulatory and client requirements.

6.0 Hot Soil Sampling Using Rotosonic Method

The procedures for hot soil sampling with a Sonic rig are similar to the steps outlined in **Section 5.2**, except for the following deviations:

- Sonic drilling methods produce large soil cores, 4 to 6 inches in diameter. Cool the cores in a large trough of ice, with drainage of melt water. Ice consumption may range from 500-1,000 pounds per day depending on soil temperature, ambient temperature, and soil core production rate.
- In ambient temperature soil conditions, Sonic drilling methods use a low-density polyethylene (LDPE) sleeve to recover soil cores from the Sonic rig sample apparatus. The LDPE bags used for

this method of sample retrieval are typically only rated for temperatures below 90°C, therefore liners must be used with additional precautions:
    - Cool the exterior of the sonic barrel with a garden hose prior to contact with the LDPE liner and extraction of the soil core. It is recommended to double-bag hot soil cores in the LDPE liners. Have an ice bath ready for immediate cooling of the soil cores.
    - Direct contact with ice below and above the bagged soil core cools the soil cores in approximately 1 hour. Additional plastic may be preferred to further eliminate risk of cross contamination but does slow the cooling rate.
- For sampling at ISTR sites where soil temperatures are greater than 90°C, lexan polycarbonate liners (or equivalent) are an alternative. Lexan polycarbonate is rated to approximately 130°C.
- Some subsurface conditions may make the lexan polycarbonate liners prohibitive.
- Verify with the drilling subcontractor that a second sample core barrel is available to maintain production while the first sample core barrel is cooling and during core extraction.
- Extreme caution will be exercised in cutting the lexan polycarbonate liners when the soil core is ready to be sampled.

7.0 RESPONSIBILITIES

Role	Responsibility
VP Operations	• Develop and implement SOPs • Periodically review and update procedures based on project feedback • Provide training and maintain training documentation
TRS Safety & Quality Manager	• Assist VP Operations with providing training and maintaining training documentation. • Assist Site Health and Safety Officer (SHSO) with modifying SOP to meet site-specific HASP requirements.
PM	• Review procedures in conjunction with site-specific sample requirements and scope of work (SOW). Coordinate changes to procedures as necessary. • Schedule and coordinate sampling effort. Ensure adequate supplies are available.
SHSO	• Conduct orientations for subcontractors and employees • Coordinate training needs with TRS SQM • Review procedures in conjunction with site-specific HASP. Coordinate changes to procedures as necessary to maintain safe working procedures.
Sampling Personnel	• Complete training to the level of competent person prior to initiating sampling activities. • Follow procedures and document information related to soil sampling effort as identified in this SOP, including and deviations from the SOP.

8.0 TRAINING

Training in SOPs is provided upon initial assignment and annually thereafter. Additional retraining is provided if there is a change in procedures or if inadequacies are observed in the individual's application of procedures. Subcontractors must train their own employees. LOTO training requirements for personnel are outlined in SOP 1.1.

9.0 RECORD KEEPING

These are standard (i.e., typically applicable) procedures, which may be varied or changed as required dependent on site conditions, equipment limitations, permit requirements, or limitations imposed by the procedure. The ultimate procedures used during any sampling event, including any deviations from these procedures, shall be documented in the sample logbook.

At a minimum, the following information shall be maintained in the sample logbook related to hot soil sampling at ISTR sites:

- Date
- Sample identification and corresponding location
- Sample time
- Sample identifications and analysis to be performed
- Chain-of-custody number
- Shipping information
- Deviations from this SOP
- Any other information deemed relevant to the sample results

Copies of chain-of-custody forms and shipping documentation shall be maintained and kept with the sample logbook.

10.0 REFERENCES

TRS Group, Inc., 2013. SOP 1.1, Lockout/Tagout (LOTO), Most Recent Version.

US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846,

Most Recent Version (Method 5035)

SOP 3.2 Hot Soil Sampling

Training Acknowledgment

All personnel that receive training on this procedure will review and sign the acknowledgement form contained in this section.

I have been trained by TRS Group, Inc. (TRS) to perform hot soil sampling at TRS ISTR project sites. By signing this document, trainee acknowledges that SOP 3.2 Hot Soil Sampling has been read and the contents of the document are understood. Trainee has received hands-on training from a competent person who is authorized to use and instruct others on sampling procedures at TRS project sites.

Date	Trainee (print)	Trainee (Sign)	Trainer

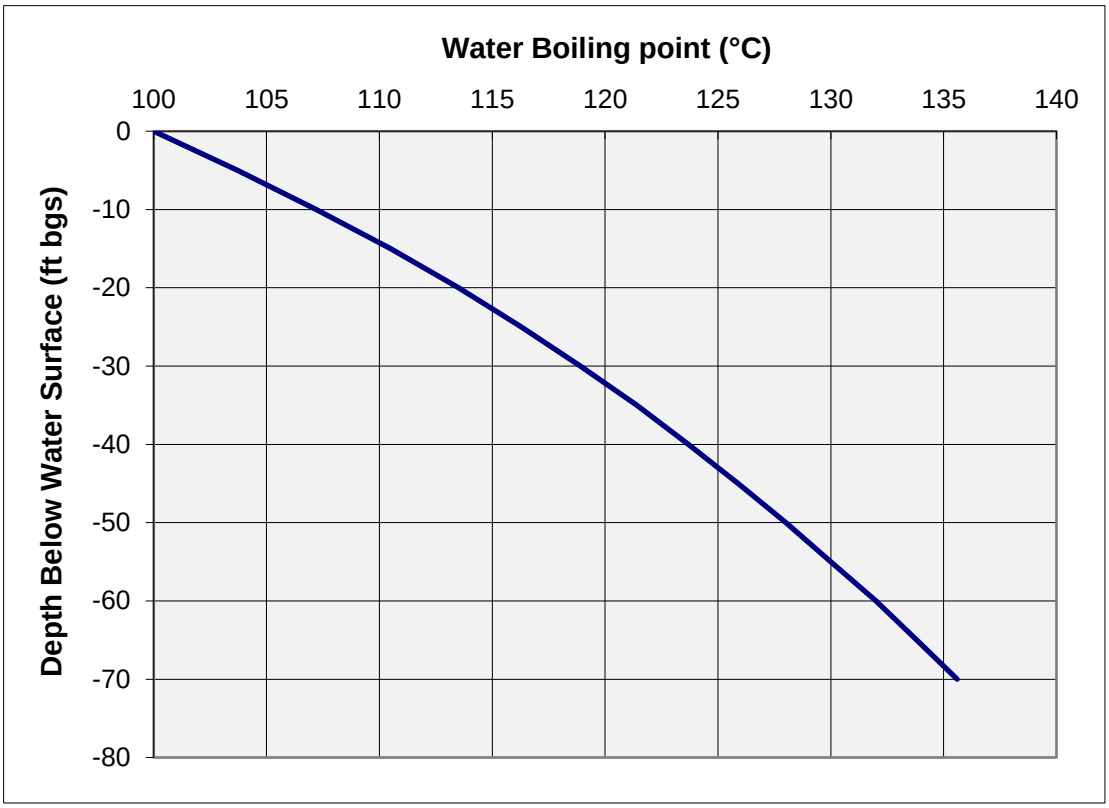
Site Sampling Evaluation Checklist

Project #: _____

Date: _____

Subsurface Conditions

1) Are soil samples being recovered from beneath the groundwater surface?
2) What is the depth to groundwater at the time of sampling?
3) How deep below the groundwater surface elevation are we sampling?
4) What are the current temperatures at or near each boring location?
5) Are there confining layers on site? Clay or silt over saturated zone sand for example.
6) Use the figure below to determine where the sites actual temperatures fit on the boiling point curve.



7) Actual temperature for each depth elevation that is higher in value than the temperatures represented by this curve suggest a temperature value greater than the hydrostatic boiling point of water.

APPENDIX E

WASTE MANAGEMENT PLAN

Prepared for:
Pechiney Plastic Packaging, Inc.
South Jordan, Utah

Submitted to:
United States Environmental Protection Agency Region II
New York, New York

Date:
December 2019

Project Number:
1690008019

WASTE MANAGEMENT PLAN

OPERABLE UNIT 3, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE WARREN COUNTY, NEW JERSEY

Ramboll
333 West Wacker Drive
Suite 2700
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Attachment 1: Region 2 Off-Site Rule Request Form

ACRONYMS AND ABBREVIATIONS

Albéa	Albéa Americas Inc.
ANC	American National Can
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cycle Chem	Enviro Cycle Chem, Inc.
GAC	granular activated carbon
GWETS	Groundwater Extraction and Treatment System
NJAC	New Jersey Administrative Code
OU	Operable Unit
PDI	Pre-Design Investigation
PPPI	Pechiney Plastic Packaging, Inc.
PVGCS	Pohatcong Valley Groundwater Contamination Superfund
QAPP	Quality Assurance Project Plan
Ramboll	Ramboll US Corporation
RCRA	Resource Conservation and Recovery Act
ROC	Regional Off-Site Contact
TCE	trichloroethylene
TCLP	toxicity characteristic leaching procedure
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1. INTRODUCTION

On behalf of Pechiney Plastic Packaging, Inc. (PPPI), Ramboll US Corporation (Ramboll) has prepared this Waste Management Plan for the site activities associated with the *in-situ* thermal treatment system installation and operation for remediation of trichloroethene (TCE) impacts in vadose zone soils in Source Area A of Operable Unit 3 (OU3) of the Pohatcong Valley Groundwater Contamination Superfund (PVGCS) Site. The *in-situ* thermal treatment system is located within the former American National Can (ANC) building at the facility presently owned and operated by Albéa Americas Inc. (Albéa) at 191 Route 31 North in Washington, New Jersey ("Site"). The Site is identified by the United States Environmental Protection Agency (USEPA) as ID# NJD981179047.

This Waste Management Plan is to provide the information needed to coordinate the off-site disposal of waste streams generated during the construction of the OU3 remedy as well as wastes generated during operation of the treatment system. The thermal treatment activities will include drilling for heater/vapor extraction wells and temperature monitoring points, installation of piping, wiring, and process treatment equipment, vapor-phase carbon for air treatment of off-gasses, liquid-phase carbon for treatment of condensation prior to discharge, backflush water from softening/conditioning of the water supply used for makeup water for the cooling towers, and wastes generated from system dismantling and demobilization at the completion of the project.

1.1 Summary of Waste Streams and On-Site Waste Management

Waste streams anticipated during the OU3 thermal treatment activities include the following:

- **General Construction Debris -** The general trash/debris do not require approval for off-site disposal and can be disposed of by the Contractor or in commercial dumpsters as appropriate. Discarded equipment may be placed with trash if free of any oil or hazardous substances.
- **Soil Cuttings -** Soils to be generated during the construction of the heater/extraction wells and temperature monitoring points are expected to be non-hazardous based on previous soil characterization testing. The waste soils are to be placed in roll-off containers to be supplied by the Contractor.
- **Soil from Excavations –** Waste soils and waste pavement materials will be generated by excavating for pipe/power line trenches that cross the west driveway, power pole installation, electrical supply duct bank installation, and installation of the condensate discharge pipe. Soils will also be generated from the excavation(s) for electrical transformer pad construction.
- **Decontamination Rinsate -** Water from decontamination of down-hole drill casing, sampling equipment, and other equipment will be containerized and then sent through the on-site groundwater extraction treatment system (GWETS). Potable water used for any general cleaning or new pipe testing/commissioning may be pumped to sediment filter bags and released for on-site infiltration, provided it has not contacted contaminated materials.
- **Expendable and Disposable Items -** Any waste hydraulic/lubricating/motor oils or used filters will be containerized and removed by the Contractor.
- **Spent Remediation Materials -** The proposed method for installation of heater/extraction wells and temperature monitoring points is sonic drilling which generates waste water. The drilling water will periodically be placed in totes and replaced with clean water. The drilling water totes are to be hauled to an on-site poly-tank for on-site GWETS for treatment then injection into the on-site injection wells. Drilling water that is silty will be allowed time for settlement of most of the

suspended solids prior to pumping to the GWETS. The settled fines will be placed in the soil roll-off box.

- **Remediation Process Waste Streams -** The proposed treatment method will generate several waste streams during operation as follows:
  - Waste granular carbon from both the vapor and the liquid treatment vessels. The spent carbon will be staged in vessels and labeled as used or spent carbon. A recycling service will be used to remove the spent carbon from the vessels and replaced with re-conditioned activated carbon.
  - Condensate water from heat exchangers and steam condensing operations. The condensate water is to be captured as noted in the design report and placed in temporary tanks, then transported to the on-site GWETS associated with the remedy for OU1 – TCE (Groundwater). The condensate water will be neutralized (if acidic) prior to treatment with liquid phase granular activated carbon (GAC). The GWETS will treat the condensate water and send it to the on-site injection wells.
  - Bag filters and miscellaneous waste in drums. The drums will be hauled off site for disposal as needed.
  - Waste water generated from backflushing of water softeners for conditioning of make-up water for use in the cooling towers will be stored in a temporary tank. A recycling service will be used to remove the backflush water from the tank and transport it off-site for disposal.

The OU3 treatment is not expected to generate hazardous wastes.

1.2 Regulatory Requirements and Exemptions

Waste streams generated during the Pre-Design Investigation (PDI) activities at the Site that require off-site disposal shall be characterized in accordance with the Code of Federal Regulations (CFR), specifically 40 CFR Part 260 and 261, and New Jersey Administrative Code (NJAC) 7:26 and handled in accordance with 40 CFR 300.440 (i.e., Off-Site Rule). The Off-Site Rule requires that Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes may only be placed in a facility operating in compliance with the Resource Conservation and Recovery Act (RCRA) or other applicable Federal or State requirements so that wastes generated from response actions authorized or funded under CERCLA do not contribute to present or future environmental impact. In addition and as stipulated in 42 U.S. Code 9621(d)(3), "in the case of any removal or remedial action involving the transfer of any hazardous substance or pollutant or contaminant off site, such hazardous substance or pollutant or contaminant shall only be transferred to a facility which is operating in compliance with section 3004 and 3005 of the Solid Waste Disposal Act [42 U.S. Code 6924, 6925] (or, where applicable, in compliance with the Toxic Substances Control Act [15 U.S.C. 2601 et seq.] or other applicable Federal law) and all applicable State requirements."[1]

Section 121(d)(3) of CERCLA applies to any CERCLA response action involving the off-site transfer of any hazardous substance, or pollutant or contaminant (CERCLA wastes).[2] Should a hazardous waste stream be generated, an addendum to this Waste Management Plan will be submitted to the USEPA.

[1] http://www.law.cornell.edu/uscode/text/42/9621

[2] http://www.epa.gov/waste/hazard/wastetypes/wasteid/offsite/index.htm

2. NOTIFICATIONS

2.1 USEPA Notification

In accordance with the Off-Site Rule, USEPA approval and determination of the proposed disposal facility's Off-Site Rule status is required prior to off-site transportation and disposal of the OU3 waste streams. Since the CERCLA Off-Site Rule approval is dynamic in nature, an initial status inquiry will be made with the USEPA Region in which the proposed disposal facility is located to determine the facility's status, and an additional status inquiry will be made approximately 1 week prior to shipment. All inquiries are to be made via email to the Regional Off-Site Contact (ROC)[3]. Contact information for Region 2 and Region 9 ROCs are as follows:

- Region 2: Beckett Grealish
  - email: Region 2_OSR@epa.gov
  - phone: (732) 321-4341
- Region 9: Kandice Bellamy
  - email: bellamy.kandice@epa.gov
  - phone: (415) 972-3304

As requested by the USEPA On-Scene Coordinator, a Region 2 Off-Site Rule Request Form is to be completed for each proposed waste shipment (regardless of the destination region) and submitted with applicable waste characterization results to the USEPA Project Manager (Michelle Granger). A copy of the form has been provided as Attachment 1 for reference.

2.2 Waste Management Coordination

Ramboll is responsible for coordination with the Albéa facility to ensure that the waste soil temporary storage and removal is conducted to minimize disruption to facility operations. For containerized wastes, Ramboll and/or the Contractor will determine a date for waste pick up and locations of the truck staging, waste handling, and loading so as not to impede the facility's operations.

Ramboll will be responsible for preparing waste profiles for acceptance by the off-site disposal facility. The Contractor will be responsible for the waste transportation and off-site disposal of the waste streams in accordance with application regulations.

2.2.1 Soil Waste

Coordination with the transportation contractor and disposal facility will be conducted by Ramboll in cooperation with project's Contractor. Ramboll will be responsible for waste profiling and landfill/facility acceptance. The Contractor will be responsible for the waste transportation and off-site disposal of all waste streams in accordance with application regulations. PPPI will be considered the Generator for all manifested waste disposal.

Soil waste streams generated during the OU3 work will be characterized via analytical testing and the results of waste characterization samples will be used to generate waste profiles. For the waste soils, a composite sample comprised of a set of six to eight subsamples will be collected from the material contained in the roll offs and analyzed for toxicity characteristic leaching procedure (TCLP) volatile

[3] http://www.epa.gov/waste/hazard/wastetypes/wasteid/offsite/index.htm

organic compounds (VOCs) and TCLP Resource Conservation and Recovery Act (RCRA) metals and/or any other waste characterization testing required by the disposal facility. All waste characterization samples will be collected and analyzed in accordance with the procedures identified in the Quality Assurance Project Plan (QAPP). Composite samples will be submitted to TestAmerica, Inc. in Edison, New Jersey. Results of the waste characterization will be evaluated in accordance with 40 CFR Part 260 and 261 and NJAC 7:26 to determine if the material is hazardous or if it meets the landfill's acceptance criteria.

Ramboll, in cooperation with Rio Tinto, will then provide necessary paperwork to generate a waste stream profile. Once the Generator approves the waste profile, a signed version of the approved profile, in addition to the analytical results from the waste characterization, will be submitted to the disposal facility. The disposal facility will contact Ramboll with the decision for approval or denial of receiving the waste stream.

It is anticipated that waste soils slated for off-site disposal will be transported to ACV Enviro Cycle Chem, Inc. (Cycle Chem) facility in Elizabeth, New Jersey.

The Contractor will set up a tentative date for pickup at the Site, noting that adequate time must be allotted in this schedule for the Generator to receive the waste manifest for approval and signature prior to the transportation of waste. All roll-off boxes will be inspected by the Contractor prior to loading to ensure that they are secured, properly labelled, and intact for transportation. The non-hazardous waste manifests will be provided by the waste facility prior to the shipment of waste. Generator information is provided below:

- Generator Name and Mailing Address: PPPI c/o Ramboll, 333 W Wacker Drive, Suite 2700, Chicago, IL 60606 (phone: 312-288-3800)
- Generator's Site Address: 191 Route 31 North, Washington, NJ 07882

All waste manifests must be reviewed by Ramboll's Project Coordinator and Rio Tinto prior to waste pickup. Either the Generator will sign the waste manifest(s) and or alternately, the Generator may provide written authorization for Ramboll to sign manifests on its behalf.

2.2.2 Condensate

Condensate generated from the OU3 treatment activities will be containerized (poly tank or other tank) and disposed of via treatment through the on-site GWETS. If on-site treatment is not available, it is anticipated that the condensate will be profiled and transported to the Cycle Chem facility in Elizabeth, New Jersey for disposal.

2.2.3 Spent Carbon

Spent GAC from the treatment process will be temporarily stored on site. Upon approval by the Generator, the spent GAC will be transported off site for regeneration/recycling. It is anticipated that the spent GAC will be sent to the Evoqua Water Technologies LLC facility in Parker Arizona or Darlington, Pennsylvania. However, alternate regeneration facilities may be proposed.

2.2.4 Water Softener Backflush Water

Waste water generated from water softener backflushing will be containerized (poly tank or other tank) and disposed of off-site. It is anticipated that the condensate will be profiled and transported to the Cycle Chem facility in Elizabeth, New Jersey for disposal.

3. WASTE TRANSPORTATION

Containerized wastes will be staged in a location determined by the Contractor in agreement with Ramboll and Albéa. Any roll-off boxes will be inspected by the Contractor prior to loading to ensure that they are secured, properly labelled, and intact for transportation.

Off-site transportation for applicable non-hazardous waste streams will be coordinated by the Contractor and the disposal facility. Ramboll will check with Albéa to ensure that the date and locations of waste hauling/pick up and handling does not impede the facility's operations. Prior to arrival on site, the transportation company will be informed of which site access route to use for the Albéa facility. A Ramboll field team member will be present on site with the signed manifest to oversee the handling and loading of all wastes.

TABLE

Table 1
Contact Information for Waste Disposal

Contact, Role, Affiliation	Address	Phone Number/Email Address
Bruce Kennington Project Director Ramboll	333 West Wacker Drive Suite 2700 Chicago, IL 60606	Phone: 312 288 3800 Email: bkennington@ramboll.com
Luis Hidalgo Project Manager/Principal Advisor, OU3 Rio Tinto	4700 Daybreak Parkway South Jordan, UT 84009	Phone: 435 932 3965 Email: luis.hildago@riotinto.com
Michelle Granger USEPA Remedial Project Manager USEPA Region 2	290 Broadway Mail Code: 19th Floor New York, NY 10007-1866	Phone: 212 637 4409 Email: granger.michelle@epa.gov

ATTACHMENT 1

REGION 2 OFF-SITE RULE REQUEST FORM

U.S. EPA Region 2 Off-Site Rule Request Form

Receiving Facility Information

Estimated Initial Shipping Date:
Estimated Shipping Completion Date:

Supporting Documentation Attached: ☐ Yes ☐ No

1.) Name of Facility Receiving CERCLA Waste

2.) Address of Facility

3.) City

4.) County

5.) State New Jersey

6.) Zip Code

7.) EPA Facility I.D. (Hazardous Waste or Municipal Waste I.D.)

Facility Type
Subtitle C ☐ Subtitle D ☐ Other ☐ _____

State Permit No.

8.) Any other pertinent I.D. numbers that may apply (License Numbers, etc.)

9.) Facility Phone Number

Contact Name

10.) Facility Fax Number (if available)

11.) Email Address

Generating Site Information

12.) Name of CERCLA Site

13.) Address of CERCLA Site

14.) City

15.) County

16.) State New Jersey

17.) Zip Code

18.) CERCLA Site I.D.

19.) CERCLA Waste Median (e.g. Soil, Water, Air etc.)

Hazardous and/or Non-Hazardous (check all that apply)
Hazardous ☐ Non-Hazardous ☐

20.) CERCLA Waste Contaminates (e.g. tce, pcb, Mercury, Lead, etc.)

21.) Amount of CERCLA Waste (e.g. Gallons, Pounds, Tons, etc.)

22.) Person Making Request(s)/Affiliation & Phone Number

(Lotus Notes Users Select Submit via Desktop email Application)

APPENDIX F

OPERATION, MAINTENANCE, AND MONITORING PLAN

Operable Unit 3
Pohatcong Valley Groundwater Contamination Superfund Site
Warren County, New Jersey

TRS Group, Inc.

In-Situ Thermal Remediation

Operations, Maintenance and Monitoring Plan

Revised: December 2019

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Abbreviations and Acronyms

µg/m^3	micrograms per cubic meter
AHA	Activity Hazard Analysis
°C	degrees Celsius
ECD	electron capture detector
E-Stop	emergency stop
GAC	granular activated carbon
GC	gas chromatograph
GWETS	Groundwater Extraction and Treatment System
HASP	Health and Safety Plan
kW	kilowatt
LGAC	liquid-phase granular activated carbon
LOTO	lock-out/tag-out
MPA	Main Production Area
NFPA	National Fire Protection Agency
NJDEP	New Jersey Department of Environmental Protection
OM&M	Operations, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCU	Power Control Unit
PID	photoionization detector
PLC	programmable logic controller
POTW	Public Owned Treatment Works
PPE	personal protective equipment
Ramboll	Ramboll, US Corporation
RCRA	Resource Conservation and Recovery Act
scfm	standard cubic feet per minute
SOP	Standard Operating Procedure
SPM	Senior Project Manager
TCE	trichloroethene
TCH	thermal conductive heating
TMP	temperature monitoring point
TRS	TRS Group, Inc.
TWA	time-weighted average
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
VAC	volts alternating current
VGAC	vapor-phase granular activated carbon
VMP	vapor monitoring point
VOC	volatile organic compound
VR	vapor recovery

1.0 INTRODUCTION

The Pohatcong Valley Groundwater Contamination Superfund Site (Site) is located in parts of Washington Borough, Washington Township, Franklin Township and Greenwich Township in Warren County, New Jersey. The Site involves primarily trichloroethylene (TCE) and perchloroethylene (PCE) contamination of the Kittatinny Limestone Aquifer underlying the Pohatcong Valley. The aquifer serves as the sole source of drinking water for public water systems and private parties in the area. The Site is approximately 10 miles long and 1.5 miles wide and is defined by the extent of two plumes of groundwater contamination, one that is contaminated primarily with TCE plume and another that is contaminated primarily with PCE plume. United States Environmental Protection Agency (USEPA) separated the Site into three operable units (OUs). OU1 addresses contaminated groundwater within Washington Borough and parts of Washington and Franklin Townships; OU2 addresses groundwater contamination downgradient of OU1 within portions of Franklin and Greenwich Townships; and OU3 addresses contaminated soil source areas within the OU1 area.

The OU3 Study Area covers the former American National Can (ANC) facility, now owned by Albéa Americas, Inc. (Albéa), and adjacent areas in Washington Borough. In situ thermal remediation (ISTR) is planned to reduce TCE to less than 1 milligram per kilogram (mg/kg) in silty vadose soils located between the depths of 60 and 125 feet below grade surface (bgs) beneath the building. The soil is described as hard, compact and dry silt with some random cobbles and boulders. The building is currently occupied and much of their work area cannot be disturbed. Albéa has allowed access for drilling from a part of the building called the former Molding Room Area to allow remediation to occur.

TRS Group, Inc. (TRS) will use thermal conductive heating (TCH) technology, combined with a vapor recovery (VR) system to remove TCE from soil. The Albéa property is located at 191 Route 31 North, Warren County, New Jersey.

This Operation, Maintenance and Monitoring (OM&M) plan contains the technical processes and monitoring planned for the operation and maintenance of the TCH treatment system. This plan may be revised as necessary to meet changes in design, regulatory requirements, or Site conditions. Any revisions to the OM&M plan will be documented and tracked by TRS at the job site.

This OM&M plan will be used in conjunction with the TRS Corporate Safety Program, the TRS Site-specific health and safety plan (HASP), and TRS Standard Operating Procedures (SOPs). The TRS standard SOPs are contained in Attachment B.

The operation of the treatment system will be split into three different groups to facilitate a faster implementation schedule and lower electrical infrastructure load. Each of the groups will have approximately one third of the soil heater wells. Heaters or heater fans along the boundary of each group will be kept online until the subsequent group has been confirmed as complete. The group heater approach will change the number of points of measurement when any group is energized or de-energized.

2.0 TCH SYSTEM COMPONENTS

The TCH system deployed for the remediation consists of the primary components listed in **Table 1**.

Table 1. TCH System Primary Components

System Component	Quantity
TCH Power Control Unit (PCU)	2
TCH Heater Wells w/Heater Elements Total	178
Co-Located Vapor Recovery (VR) Wells Total	178
Group A- Heaters and VR Wells	65
Group B- Heaters and VR Wells	47
Group C- Heaters and VR Wells	66
Temperature Monitoring Points (TMPs)	18
Steam Condenser and Associated Cooling Towers	1
Liquid Treatment System (2 x 200 lb. granular activated carbon)	1
Vapor Treatment System (vapor-phase granular activated carbon [VGAC])	2

The TCH system layout and design drawings illustrating the primary components listed above are provided in Attachment C.

3.0 CONTINUOUS INDOOR AIR MONITORING EQUIPMENT: VAPORSAFE™ SYSTEM

Continuous indoor air monitoring will be completed using a remotely controlled gas chromatograph (GC) equipped with an electron capture detector (ECD) and multiport analyzer provided by Groundswell Technologies and Hartman Environmental Geoscience called VaporSafe™. The VaporSafe™ system is capable of autonomously collecting a discrete sample from 10 individual locations in the vicinity of the ISTR system operation based on a scheduled programable sequence. Samples will be analyzed for a single VOC (TCE) with detection limits to one microgram per cubic meter (µg/m^3). The multiport analyzer will be connected to 10 separate one-eighth-inch outer diameter nylon tubes which are installed from the VaporSafe™ system to each location requiring indoor air sampling. Sample tubing is purged prior to sample collection based on the distance from the GC (e.g., longer distances require longer purge intervals). Analytical air data is available approximately 10 minutes after sample collection. The data are accessible via an internet-based data management system, called PeakSimple™, which allows authenticated users to view the data via any internet connected device. PeakSimple™ is capable of generating automated alarm notifications in the event a user-defined alarm condition is met. The alarm notification setpoint will be programmed for 7 µg/m^3 TCE based on the site-specific indoor air standard.

The VaporSafe™ indoor air monitoring system will be operational 24 hours a day and seven days per week during the entirety of the ISTR system operation. The system will automatically notify the

project engineer, TRS OM&M personnel, and the system vendor (Groundswell Technologies, Inc.) if the VaporSafe™ system is not operating.

4.0 TCH SYSTEM OPERATIONS

4.1. TCH System Commissioning and Start-up

Pre-Start-Up Activities

Prior to start-up, a final quality assurance inspection of vapor piping connections, all water piping connections, and electrical connections will be completed. Quality assurance inspections and testing will be also completed on the electrode cable connections, transformer connections, temperature monitoring points (TMPs) field box connections, condenser components, and Power Control Units (PCUs). All equipment will be visibly inspected for exterior damage, cracks or breaks, scrapes of protective coating, corrosion, structural damage, and inadequate installation or construction such as cracks, punctures, and damaged fittings.

Once final inspections are complete, TRS will perform system start-up and testing. Once testing is complete and operational readiness is approved, power application to the remediation volume will be continuous except for system adjustments, routine maintenance, and scheduled soil sampling events.

Equipment Prove-Out

Each component of the ERH remediation system will be operated and tested for functionality of all controls, pressure tested for leaks (water bearing systems only) rotations checked (as applicable), and interlocks tested to verify proper operation and result(s). A comprehensive equipment prove-out checklist (a TRS internal and confidential document) is completed as a final quality assurance that the system is ready for operation.

Prove out will be performed on the ERH condensers, VR blowers, PCUs (except power application to the treatment volume), Vapor phase granular activated carbon (VGAC) and support equipment, SDTXs, and field boxes for the resistive thermal detectors (RTD) and interlock).

VaporSafe™ Indoor Air Monitoring System

The VaporSafe™ indoor air monitoring system will be fully functional approximately two to three weeks prior to TCH system commissioning and startup. In advance of performing TCH system startup, perform the following:

1. Confirm VaporSafe™ indoor air monitoring system is operational, programmable sampling schedule is functioning properly and collecting indoor air data at selected locations according to the designated sampling frequency.

2. Observe the VaporSafe™ system transition to separate sample port and sample collection.

3. Observe the indoor air concentration value and verify logged concentration to internet data storage platform.

ERH System Startup

Prior to energizing the ERH system, a two-step TRS Site Quality and Safety Inspection will be performed to ensure personnel safety at the time of initial power application. The first phase of this inspection demonstrates that all design safety features have been completed and are operating properly prior to applying electrical power to the treatment volume. Examples of these safety features include: access guards, interlocks between system components, over-temperature gauges, and emergency stop switches.

Upon completion of the two phases of start-up, the TRS project manager will confer with an authorizing TRS employee to review and document operational readiness. Upon concurrence of operational readiness and with approval from the authorizing TRS employee, the TCH system will segue into full-time operations.

4.2. TCH System Operation

Once the TCH system start-up procedures have been completed, TRS will provide Site visits weekly for adjustments, visual inspections, data collection, and maintenance of the TCH system and routinely monitor the system remotely. Additional trips will be made as necessary to ensure the TCH system is functioning efficiently and effectively as designed.

During the initial heat-up period of TCH operations, parameters such as TCH heater power distribution, TCH heater casing temperatures, subsurface temperatures, condensate production, and volatile organic compound (VOC) concentrations in the recovered soil vapors will be measured. This data will be used to assess the efficiency of the TCH system and allow TRS personnel to target specific areas of the Site and optimize the efficiency of the system. Periodically, individual heaters, heater zones, and vapor treatment operations will be reconfigured to control the amount and location of heating energy applied to the subsurface. These adjustments will be determined by the TRS project team based on review of operational data collected and analyzed throughout the treatment operation.

It should be noted that parameter monitoring documented in this plan can vary. TRS will determine operating parameters based on actual site conditions during operations. Operational decisions will be determined to optimize the efficiency of the TCH system while maintaining the highest regard for safety. The heater wells, heater elements, piping, and system equipment have been designed to allow flexibility of system operations. Summaries of typical system adjustments that will be performed are provided below:

- Heater Element Performance: Subsurface heat-up rates, electrical measurements, and general lithology data will be used to evaluate performance for each heating element. Adjustments to the PCU output voltage, transformer configurations or circuit resistance modifications will be made as necessary to enhance performance. The TRS TCH Heater is designed to operate at a steady resistance regardless of temperature. Therefore, heater performance is easily predictable and calculated even as site conditions change.
- Vapor Capture: Vapor recovery wells at each heater well are fitted with valves that will allow for air flow adjustments. The VR wells for each group will be left online even after the group has been shutdown, however the individual flow rates will be adjusted due to lower steam production. Additionally, the flow rate of the blower will be adjustable by variable frequency drive and/or the manual dilution valve. Total flow at the blower and subsurface

temperature data will be evaluated to make valve adjustments that will optimize vapor capture and treatment.

4.3. TCH System Operation Safety Hazards

There are certain hazards associated with TCH during the *in-situ* heating of soil. These hazards include possible contact with hazardous voltage, steam, hot surfaces or hazardous chemicals. Exposure to these hazards can be mitigated through engineering controls and strict adherence to documented procedures and safety protocols. All operation and maintenance activities will be conducted in accordance with the site-specific HASP. Please refer to the HASP (TRS, 2019) for details of safety hazards, precautions, and procedures.

Noteworthy safety restrictions are as follows:

- Only trained, authorized personnel shall enter the TCH restricted zone (TCH compound), as depicted on Figure M101 in the system design plans (Attachment C), to complete project tasking, unless escorted by a TRS representative. TCH Restricted Zone training will be completed in accordance with the TRS HASP. Untrained personnel shall always be escorted by a TRS representative.
- Outdoor work will cease in the event of an electrical storm. Personnel will seek shelter in a building or enclosure if the potential for lightning strikes exist. Refer to the HASP for more information.
- No drilling or digging shall occur within 10 feet of any operating heaters without written approval by TRS and review of the SOP to prevent contact with energized components. TRS hazard communication to potentially affected persons or properties will be prepared and provided to Ramboll US Corporation (Ramboll) for distribution by Ramboll. Signs will be posted around the perimeter of the TCH restricted zone indicating the area is under active remediation and entry is restricted. Signs will include contact information for project management.

Power Control Unit

Each TCH PCU is equipped with an emergency stop (E-Stop) button on the outside of the PCU next to the control room entrance of the PCU. Additional E-Stops will be installed at the entrance to the compound. Note: E-stop buttons only interrupts power distribution to the heater elements and does not affect the VR equipment.

E-Stops will only be used in the case of an immediate, dangerous emergency!

If conditions do not present an immediate danger to life, health, or property, the TCH heaters and/or TCH equipment should be de-energized in a controlled and planned manner to avoid system upsets.

- Electrical hazards: 3-phase, 480 volts alternating current (VAC) energy from the local utility will provide power to the PCUs. The incoming voltage will be adjusted within the PCU prior to distribution to the intended load. Prior to working on electrical devices, power will be removed from the device and lockout/tagout (LOTO) procedures will be in place in accordance with TRS SOP 1-1 (Attachment B). All TRS field personnel working within equipment panels shall be trained to a level of competent person and have completed Arc Flash safety training in accordance with National Fire Protection Association (NFPA) 70E.

- Moving Parts: Fans within the PCU are used for transformer cooling. The fans are covered by a protective shroud to prevent foreign object damage. However, LOTO procedures will be followed when performing maintenance on the fan.

TCH Heaters

Each TCH heater will be connected to a single phase, alternating current power supply. The power supply could be more than one appliance in a series; PCU, transformer, breaker panel or junction box. Prior to working on heaters or accessing heater wells, power will be removed and LOTO procedures will be in place in accordance with TRS SOP 1-1.

- Electrical hazards: Within the heater well and heater connection locations, hazardous voltages can be present. Prior to accessing any electrical connections or heater wells, power will be removed and LOTO procedures will be in place in accordance with TRS SOP 1-1.
- Steam and Heat hazards: TCH heaters and heater wells will become extremely hot once energized. Materials close in contact to the heater or heater well may also become hot. The VR piping extending from the heater wells will also have elevated temperatures. Care should be taken around these items to prevent accidental contact with elevated temperatures.
- Once de-energized and LOTO procedures are activated, always handle heater components with proper gear and assume components will be hot. Heater temperatures will begin to cool once exposed to ambient air. Check heater surface temperatures with a temperature measuring device prior to commencing work on heater. Due to the length of the heater, additional spotters and pedestrian control devices should be deployed along the heater length.

VR Blower

The VR blowers are safety interlocked to the PCUs to stop the distribution of electrical power to the heaters should the blowers cease to operate for any reason. The blowers are housed in weather-tight enclosures that provide security and noise insulation. When working on or around the blowers, personnel shall be made aware of specific hazards which may include:

- Electrical hazards: There are two separate power supplies connected to each blower; main blower power, 3-phase, 480 VAC and a separate 120 VAC power supply for controls and interlocks. Prior to working on electrical devices, power will be removed and LOTO procedures will be in place in accordance with TRS SOP 1-1. All TRS field personnel working within equipment panels shall be trained to a level of competent person and have completed Arc Flash safety training in accordance with NFPA 70E.
- Moving Parts: The motor and associated belts used to move air through the blower are covered by a protective shroud. LOTO procedures will be followed when performing maintenance on the fan or motor.

Vapor and Condensate Recovery and Treatment

The components of the condensers are housed in weather-tight, galvanized steel enclosures that provide security and soundproofing. The condenser will be interlocked to the PCU to stop energy distribution to the heaters should the condenser cease to operate for any reason. Vapor recovery and treatment-specific hazards may include:

- Electrical hazards: Condenser primary power is 480 VAC, 3-phase. Power will be removed and LOTO procedures followed when working on electrical devices in accordance with TRS

SOP 1-1. All TRS field personnel working within equipment panels shall be trained to a level of competent person and have completed Arc Flash safety training in accordance with NFPA 70E.

- Steam & Heat hazards: During operation of the condenser, steam and vapor at elevated temperatures are continually being processed and will elevate the temperature of condenser process components. Be especially aware of the knock-out pots, the heat exchanger, vapor stream piping, and hot water conveyance piping. Piping that is expected to be extremely hot will be labeled with a corresponding warning.
- Pressurized Water/Piping hazards: The circulation piping used to cool the vapor stream in the condenser cooling towers is often under pressure and may become a hazard if ruptured. Leaks and any sign of piping fatigue will be monitored and repaired promptly when discovered.
- Slips and Trips: The complex network of piping contained in each condenser creates potential slip and trip hazards. Always move cautiously in and around the condenser and be aware of slick and unstable surfaces.
- Chemical Exposure hazards: Operation of maintenance of the condenser has the possibility to present chemical exposure hazards to Site personnel.

The condenser contains a condensate filter which filters water prior to discharge to liquid-phase granular activated carbon (LGAC). In the event this filter needs to be replaced, proper personal protective equipment (PPE) shall be utilized by Site personnel to ensure exposure is minimized. TRS personnel will follow the task-specific activity hazard analysis (AHA) for completing this task.

5.0 INSPECTIONS AND MAINTENANCE

TRS will perform regularly scheduled inspections and maintenance on all equipment items for the duration of TCH operations, consistent with the TRS process equipment operations and maintenance (O&M) manuals (copies of which will be maintained on-site in the PCU) and the manufacturer's recommendations. Data gathered during system monitoring, including visual inspections, may also indicate that additional maintenance will be required. Each maintenance event will be recorded in the project field notes and noted in the specific equipment's lifetime maintenance log (utilizing an internal maintenance tracking database). The log will include the date the maintenance was performed, the task, parts replaced, future recommendations, and who performed the task.

5.1. Inspections

Routine inspections by qualified personnel are an important component of TCH treatment system operations and will be performed daily when TRS personnel are on-site. Any concerns identified during inspections will be brought to the attention of the TRS Senior Project Manager (SPM) and the TRS Equipment Manager and an appropriate course of action, including repairs, shall be completed as soon as possible.

Daily Inspections

On a daily basis, personnel will confirm the automated, electronic data collection is occurring according to design. Based on available data, personnel will also make any necessary changes to

power application and the vapor recovery rate. An overall Site walk will be conducted when staff is on-site to observe indications of any equipment malfunctions, leaks, or changes in Site conditions.

Weekly Inspections

TRS will complete a weekly work site inspection. During the weekly visual inspections, personnel will also check the warning placards located around the Site perimeter. Weekly inspections will include, but are not limited to the following items:

- First aid kits and bloodborne pathogen kits are adequately stocked
- Eye wash station is properly functioning
- All project plans are available to project personnel
- The SOP compendium is current and complete
- The AHA compendium is current and complete
- Portable toilet facilities are clean and maintained
- PPE is clean, stocked, and ready for use
- Hazardous materials are labeled and stored properly
- Tripping hazards are addressed

5.2. TCH Heaters

TRS personnel will walk the heater field routinely during operations to visually observe for the following items:

- Abnormalities to equipment and equipment cabling
- Ensure the ground connection for each heater is secure and clean
- Verify all surface penetration seals are intact and no leaks detected

In addition, TRS personnel will verify daily that all relevant heaters are energized and functioning at anticipated levels. It is common to hear a slight vibration emitting from the TCH heater casing. Testing a heater for operation and power can be performed using a clamp meter. The clamp meter should be set to the alternating current mode. A current measurement less than 1 indicates the heater is not functioning.

5.3. TCH Condensers and Cooling Towers

Condenser and cooling tower operations, inspections and operational monitoring, trouble shooting, and maintenance will be in accordance with TRS internal O&M manuals. **Table 2** contains a maintenance schedule for the condenser and the cooling tower.

Table 2. Steam Condenser Maintenance Schedule

Procedure	Monthly	3 Months	6 Months
Inspect general condition of cooling towers.	●		
Check water level in holding tank water basin. Adjust as necessary.	●		
Check float switches and make-up valve for proper operation.	●		
Check belt tension and general condition of cooling tower V-belts.	●		
Check the line voltage and motor amperages	●		
Clean outside of cooling tower blower motors to help assure proper cooling.		●	
Lubricate blower bearings using a low-pressure grease gun		●	
Check blower sheaves for dirt buildup that can cause unbalance and vibration.		●	
Inspect and clean (rinse off) the low-low, low, high and high-high level switches.		●	
Clean and flush holding tank. Lubricate electric motors using a low-pressure grease gun.			● ●
Lubricate motor base and mounting adjusting screw.			●

5.4. Vapor Recovery Blowers

Blower safety considerations, operations, inspections and operational monitoring, trouble shooting, and maintenance will be in accordance with the internal TRS O&M manual. Basic maintenance service needs include:

- Lubrication
- Checking for locations of abnormal, elevated temperature
- Checking for increases or changes in vibration and noise
- Recording of operational pressures and temperatures

Lubrication is typically the most important consideration of blower maintenance. Lubrication practices will be in accordance with the manufacturer's instructions. Grease will be added using a hand-powered grease gun in order to prevent damage to the seals by adding grease too quickly. Note: The grease used for the blower drive end and the motor bearings are not interchangeable, refer to the manufacturer's recommendations for the correct grease type. Belt tension (if

applicable) will be checked periodically and belts inspected for frays or cracks. VR blower maintenance schedule is provided in **Table 3**.

Table 3. Blower Maintenance Schedule

Procedure	Bi-weekly	Monthly	Every 6 Months
Add Polyrex™ grease with hand-powered gun to drive (lobe) end.	●		
Check hour meter. Change oil every 2,000 hours.	●		
Check lubricant levels in the gearbox and bearing reservoirs.	●		
Inspect air inlet filter. Replace quarterly or more frequently if necessary.		●	
Inspect for surface corrosion.		●	
Inspect overall condition of blower (new, worn, safety hazard, etc.).		●	
Inspect bolt/fittings for tightness.		●	
Check for hot spots.		●	
Check for increases or changes in vibration and noise.		●	
Inspect V-belts for damage/wear. Replace if necessary.		●	
Inspect dilution valve inlet Filter for serviceability. Replace if necessary.		●	
Lubricate electric motor with Shell GADUS™ grease or equivalent.			●

5.5. Vapor-Phase Granular Activated Carbon System

VGAC change outs will occur if the primary VGAC vessel samples show signs of breakthrough. The potential for breakthrough will be monitored for total VOCs during operational data collection using a PID. In addition, PID data may be correlated with laboratory results to support change out decisions. Should field data indicate the need for carbon change out, TRS may collect a sample for off-site laboratory analysis to support the decision. Once data confirms field screenings of exceedance, TRS will remove the primary VGAC vessel. At this time, the secondary VGAC vessel will become the new primary vessel and the old primary (with new VGAC) will become the secondary.

TRS will work to minimize effluent concentrations, but more specifically, change-outs will certainly occur under the following criteria:

- Nuisance odors are present;

- Ambient air monitoring shows onsite worker health and safety is at risk; or
- Concentrations are at or near discharge limits specified in the air permit.

6.0 SYSTEM OPERATIONS AND PERFORMANCE MONITORING

System performance monitoring is critical to the operation of the TCH system. This activity provides the information necessary for the project team to make informed decisions concerning the safe, efficient, and effective operation of the TCH system. The types of performance monitoring to be completed include:

- Process System Monitoring
- Wellfield Temperature Monitoring
- Wellfield Vapor and Vacuum Monitoring
- Vapor Emissions and Condensate Monitoring

TCH operations will run continuously 24 hours per day, seven days per week from the start of heating until the target in-situ soil temperature has been reached and project performance goals have been achieved. The operation will be attended by TRS' System Operator(s) on a weekly basis during normal operation. The system operations will be monitored automatically 24 hours per day, seven days per week. System Operator(s) and TRS' Project Engineers will have the ability to remotely access the system at any time, as needed to support the onsite System Operator(s). The local System Operator(s) will receive a notification via phone, email or short message service (SMS) text if there is a system alarm that requires their presence onsite. The System Operator(s) will mobilize to the Site as soon as possible to troubleshoot the alarm condition.

6.1. Process Treatment System Monitoring

Power control unit (PCU) controls and data acquisition are performed on a dedicated computer and associated programmable logic controllers (PLCs). Remote data acquisition software is used to collect and store subsurface temperatures, power, voltage, amperage, and operational status data for the entire TCH system. TRS is able to view and download this information in real time using a high-speed, wireless modem. The software also allows for control and/or monitoring of power application, vapor condensation, and liquid pumping functions.

During operations, TRS personnel will be on-site each week to perform routine system monitoring activities and review system performance. Data collection parameters, method of data collection, and frequency of measurement for the general process treatment system components are shown in **Table 4**.

Table 4. Process System Data Collection Method and Frequency

Data Product	Manual Collection Frequency	Electronic Collection Frequency
Verify Heater Power Application	Weekly	-
PCU Output Voltage, Current, and Power	-	Daily
PCU Input Energy	Weekly	Daily
Group VR Header (HX and PID)	Weekly	
Vapor Treatment System (PID)	Weekly	-
TMP Subsurface Temperatures	-	Daily
Vacuum Switch	Weekly	-
Condenser Operational Data	Weekly	Daily
Blower Operational Data	Weekly	-
Total VR System Airflow	-	Daily

TRS utilizes a computerized data collection system for automated data collection of the process treatment system operations. Electronic Site data is processed and collected by the computer located within each PCU. The types of parameters to be monitored electronically include subsurface temperature, various condenser and vapor treatment system temperatures, vapor flow and temperature, and the parameters of energy input. A summary of electronic data collection parameters for each condenser, blower and PCU are included in **Table 5**.

Table 5. Process Treatment System Electronic Data Collection Parameters and Frequency

Parameter	Units	Frequency
Output Phase A	Volts	1x/day
	Amps	1x/day
	kW	1x/day
Output Phase B	Volts	1x/day
	Amps	1x/day
	kW	1x/day
Output Phase C	Volts	1x/day
	Amps	1x/day
	kW	1x/day
Total Energy	Megawatt hours (MWh)	1x/day
Control Room Temperature	°C	1x/day
Aux XFMR Room Temperature	°C	1x/day

Parameter	Units	Frequency
Main XFMR Room Temperature	°C	1x/day
Blowdown Volume	gallons	1x/day
Condensate Volume	gallons	1x/day
Make Up Water Volume	gallons	1x/day
Effluent Air Flow Rate	SCFM	1x/day
Vapor HX In Temperature	°C	1x/day
Vapor HX Out Temperature	°C	1x/day
Water HX In Temperature	°C	1x/day
Water HX Out Temperature	°C	1x/day
Ambient Temperature	°C	1x/day
Blower Effluent Temperature	°C	1x/day
Blower Effluent Flow Rate	SCFM	1x/day
VGAC Effluent Temperature	°C	1x/day
Stack Temperature	°C	1x/day
Stack Flow Rate	SCFM	1x/day
12 TMP locations in molding room	°C	1x/day

SCFM = standard cubic feet per minute

The data collected from the process operation will be automatically data-logged on a daily basis and stored in the project database. Remote data acquisition software is used to collect and store subsurface temperatures, power, voltage, amperage, and operational status data for the entire TCH system. TRS personnel will observe and manually record all operational data from the TCH condenser, vapor recovery blower, on a weekly basis. This data will be entered into the Site operational data collection database and reviewed for performance within manufacturer specifications and design expectations.

Manual collection and recording of some system parameters will be performed during the operation of the TCH system. Manual data collection will be performed at monitoring locations that cannot be fitted with an electronic data logger, or where electronic data logging is not appropriate because the parameters change very slowly. In general, temperature, electrical parameters, and flow conditions are collected electronically and other data, such as subsurface vacuum, process room temperatures, and pressures are collected manually. The types of parameters that will be monitored manually using a hand-held instrument or gauge include pressures throughout the treatment system, flow rates and total flows of various water and air streams within the aboveground portion of the TCH system, and VOCs in TCH process piping. Part of this monitoring includes weekly manual data collection of the two TMPs located at grade in the Main Production Area (MPA). PID and vacuum measurements will also be collected at the three vapor monitoring points (VMPs) located in the Former Molding Room and the two VMPs located in the MPA. Manual data will be recorded onto the TRS Operational Data Collection Forms, included in **Attachment A**.

All collected data, whether by electronic or manual means, will be incorporated into the project database as new data is received. Prior to data transfer to off-site personnel or locations, on-site personnel will perform a field comparison of the current day's data with the prior day's data to check for atypical measurements. A note will be added to the current day's field log when an atypical or unexpected measurement is recorded. Typical responses to atypical recordings include verifying anomalous data, troubleshooting processes, and making changes as appropriate.

TRS system operators will also record volume totals for all water totalizing meters. TRS will record data from the following water totalizer meters:

- Make-up water supplied to the cooling towers
- Condensate production
- Total condensate discharge to the Groundwater Extraction and Treatment System (GWETS)

Water totalizing meter volumes within the condenser are recorded electronically on a daily basis and recorded on the Operational Data Collection Form (**Attachment A**). Manually collected volumes will be compared against the electronically data-logged values for confirmation of proper function and the totalized volumes will be included in the monthly report.

6.2. Wellfield Temperature Monitoring

Subsurface thermocouples will be in 18 TMPs to provide suitable data for subsurface temperature monitoring. These data are used to monitor heating progress, identify potential problematic areas and may also be used to determine the locations of unanticipated heat loss or for increasing heater output, if required. Subsurface temperatures will be measured at approximately 10 feet vertically above the TTZ and every 5 ft within the TTZ. These devices will automatically record temperature data to document heating progress. Thermocouples located next to select TCH heaters are also monitored continuously and used for manual adjustments of the applied power from the PCUs.

6.3. Wellfield Vapor and Vacuum Monitoring

Wellfield Group Main Piping Headers

Vapor monitoring will be conducted with a PID in each of the wellfield group main piping headers (Group A, B, and C) so that vapor concentrations extracted from each TCH heater group can be documented. PID measurements from each of the group main piping headers will be collected weekly. The heater group PID measurements will be collected with a vacuum pump equipped with a desiccator and Tedlar® bag at the designated field sampling port (SP100A, SP200B, and SP300C) as shown on the P&ID in the drawings contained in Attachment C. Before the vapor sample can enter the Tedlar® bag, the moisture level and vapor stream temperature will be reduced to near ambient conditions. All PID readings will be recorded on the Field Data Sheets in Attachment A.

Summa® canister samples will be collected twice per month from each of the three group main piping headers A, B, and C during heating of each group. Summa can samples will be collected using a desiccator or condenser at each field sampling port (SP100A, SP200B, and SP300C) to reduce moisture level and vapor temperature before collection of the sample into the Summa can. The samples will be submitted to Accutest Laboratories of Dayton, New Jersey, a licensed New Jersey laboratory, for USEPA TO-15 analysis as a verification of the field PID readings.

Subsurface Vapor Monitoring Ports

Subsurface vacuum and total VOC vapor concentration will be measured at each vapor monitoring port (VMP) during TCH operation on a bi-weekly basis. Magnehelic gauge and PID measurements will be collected at VMP-1A through H, VMP-2A through H, VMP-3A through H, VMP-4A through C, and VMP-5A through C and recorded on the field log sheet/data forms contained in Attachment A. PID measurements will be collected using a vacuum pump equipped with a desiccator and Tedlar® bag at each VMP screen depth interval.

6.4. Vapor Emissions and Condensate Monitoring

Vapor emissions and condensate monitoring will be completed on a periodic basis. The frequency of sample collection is specified in Attachment D – Field Sampling Schedule. Samples collected from the vapor treatment process equipment and liquid treatment process equipment will be designated with the following format:

[SAMPLE LOCATION]-[SAMPLE PORT TAG NO.]-[DATE]

The sample location designator to be used for this project includes the following:

1. Influent (“INF”) - influent sample; can be used to designate a vapor or condensate sample collected at the activated carbon system influent line where it enters the treatment system (e.g., SP701 or SP801).
2. Midfluent (“MID”) - midfluent sample; can be used to designate a condensate sample collected from a sample port of the system treatment process between the influent LGAC and effluent LGAC (e.g., SP802).
3. Effluent (“EFF”) - effluent sample; can be used to designate a vapor or condensate sample collected at the effluent sample port of the treatment system, where it exits either the VGAC or LGAC effluent sample port (e.g., SP703 or SP803).

The sample port tag numbers are included on the Process and Instrumentation Diagrams of the design drawings contained in Attachment C. The date will be included in the “YYMMDD” format. For instances in which more than one sample is collected from a given sample location and sample port in a single day (i.e., multiple rounds of samples collected during startup), a numeric indicator will be included after the date. If only one sample is collected from a given sample location and/or sample port in a single day, then the numeric indicator after the date does not need to be included.

Vapor samples collected for the purpose of quality assurance/quality control (QA/QC) will have the “D” identifier appended to the end of the sample designation to designate the collection of a field duplicate. Condensate water samples will not require QA/QC items.

Example sample designations are as follows:

- INF-SP701-200816 refers to an influent (INF) vapor sample collected from sample port SP701 on August 16, 2020 in the only round of sampling for that day.

- MID-SP802-201114-D refers to a field duplicate of a midfluent water sample collected from the sample port SP802 on November 14, 2020.
- EFF-SP703-200816-2 refers to an effluent vapor sample collected from sample port SP703 on August 16, 2020 in the second round of sampling that day.

Vapor and condensate samples will be collected and shipped/delivered under routine chain-of-custody procedures. Condensate samples will be stored in coolers on ice after sampling and maintained at approximately four degrees Celsius. This includes the use of a field logbook to document sample collection and other field activities, as well as sample labels and chain-of-custody forms for shipping containers. Standard forms and field logbooks will be maintained throughout the duration of the remediation project for each sampling event. Field logbooks shall include relevant sampling information, such as sampling location, date and time as well as weather conditions, field measurements, sampling equipment used, difficulties encountered during sampling, and other pertinent data.

Vapor Emissions Monitoring

Vapor emissions monitoring of the aboveground treatment system will be done by performing both air monitoring screening and air laboratory sampling for compliance. TRS will measure VOC concentrations of vapor influent and effluent using a PID on a weekly basis per TRS internal SOP 3-3: Vapor Sampling. A proposed sampling schedule is included in Attachment D. VOC concentrations will be measured at the influent (sample port SP701), midfluent (sample port SP702), and effluent (sample port SP703) locations of the vapor treatment system with a handheld PID by a system operator onsite. Zero/span calibration of the PID following the manufacturer's calibration guidelines will be conducted prior to each use. All PID readings will be recorded on the Field Data Collection Forms and sent to TRS' project team for review and recordkeeping.

Summa® canister samples will be collected twice per month from the influent and monthly from the effluent. Samples will be collected from the influent and effluent sample ports on the VGAC treatment system and submitted to Accutest Laboratories of Dayton, New Jersey, a licensed New Jersey laboratory, for USEPA TO-15 analysis as a verification of the field PID readings and for compliance with the New Jersey Department of Environmental Protection (NJDEP) Air Pollution Control Preconstruction Permit and Certificate to Operate. Influent analytical results will be used to track ISTR VOC removal quantities. Effluent analytical results will be used to verify concentrations are below permitted concentrations.

Vapor emissions monitoring requires quality assurance/quality control (QA/QC) sample collection. QA/QC samples will consist of the preparation of field duplicates at a rate of one duplicate per 20 analytical samples submitted for analysis.

Condensate Treatment Monitoring

Analytical monitoring of VOCs in the liquid phase of the aboveground treatment system will be performed monthly. A proposed sampling schedule is included in **Attachment D**. Three condensate samples will be collected from the LGAC system at the following locations:

1. LGAC influent (Sample Port SP801),
2. Between the LGAC units (Sample Port SP802), and
3. LGAC effluent (Sample Port SP803)

Condensate samples will be collected for a full-list of VOCs using USEPA method 8260C analysis and 1,4-dioxane using USEPA method 8260 SIM. Analytical data will be used to verify the efficacy of the LGAC and to verify concentrations of the condensate being discharged into the GWETS. If laboratory analysis indicates VOCs between the LGAC units, the lead LGAC unit will be changed with virgin LGAC.

QA/QC samples are not required for condensate monitoring sampling.

6.5. Indoor Air Monitoring

Continuous indoor air monitoring will be performed using the VaporSafe™ system which is set up to autonomously collect a discrete sample from 10 individual locations on a scheduled programable sequence. The ten locations are listed below:

- ISTR-IA1: Former Molding Room – Northwest
- ISTR-IA2: Former Mold Storage Room
- ISTR-IA3: Former Molding Room - South
- ISTR-IA4: Former Molding Room - Northeast
- ISTR-IA5: Men's Locker Room - West
- ISTR-IA6: Women's Locker Room - West
- ISTR-IA7: Men's Locker Room - East
- ISTR-IA8: Women's Locker Room - East
- ISTR-IA9: Plastic Maintenance Shop
- ISTR-IA10: Offices

Individual air samples will be analyzed for TCE and sampled once per hour. Analytical air data is available approximately ten minutes after sample collection via an internet-based data management system. An alarm notification will be established for TCE concentrations using a time-weighted average (TWA) of 7 $\mu g/m^3$ over an eight-hour period for each of the 10 monitoring locations.

If there is an indoor air quality exceedance alarm, Ramboll will be notified via e-mail or text message and will immediately contact TRS to communicate the details of the alarm (location, time of alarm, measured concentration, etc.) and to discuss the appropriate response action(s) based on the information available. Ramboll may also engage the current operations and maintenance contractor for the vapor intrusion mitigation system (GWTT, Inc.) to assist with possible start-up of the auxiliary soil vapor extraction system and/or adjustment of the current extraction rates on the 500 scfm vapor mitigation system.

7.0 REPORTING AND COMMUNICATION

During TCH operations, bi-weekly status reports will be submitted to Ramboll, via electronic letter reports. These reports will describe the general operation of the TCH system, work performed during the previous week, and anticipated upcoming work. The reports will also contain data on the subsurface temperature profile.

8.0 SECURITY AND SITE ACCESS CONTROL

Site security and control is a priority task for the project team. Site control applies not only to the authorized personnel working on-Site, but also to visitors and the possible unauthorized intruder. TRS will work to tightly control access to the Site for the duration of all fieldwork, system operations, and demobilization. Site staff will be instructed to maintain constant vigilance throughout the project and to challenge on-Site visitors they do not recognize.

Site security and control will include the use of physical barriers and electronic security systems. A fence with locking gates will be installed around the TCH equipment compound. All visitors to the Site will be required to sign in and sign out with the on-Site TRS personnel. Access to the TCH compound will not be granted without escort by TRS, or explicit training and permission. The following describes the security measures to be implemented specific to the TCH system:

- TRS will maintain a visitor's log and a Health and Safety training log that will record the first visit made by TRS employees and non-employees. The logs will contain the visitor's name, company name, and a check-off to indicate that the visitor was given the required Site safety and control information.
- TRS will coordinate with personnel at the facility to ensure the perimeter fence is secured when personnel leave the Site. TRS will also train appropriate Ramboll personnel on the locations of the protocols regarding TRS perimeter security measures, e-Stop locations and consequences, and emergency procedures.
- TRS will maintain a camera security system comprised of wireless, motion-activated cameras for the duration of construction, operations, and decommissioning. When activated, the camera transmits a 10-second video clip to the security system provider dispatch to be evaluated for unauthorized entry. TRS personnel also receives the video clip via e-mail. If unauthorized entry is detected, the dispatch office will contact TRS for specific direction. If an intruder is identified in the video clip provided, TRS will request dispatch local police. The camera-system is not safety interlocked with the PCUs or any other remediation equipment.
- During operations, TRS will maintain an infrared motion sensing security system that will surround the interior perimeter of the operating TCH equipment compound. The motion-sensing security system will be safety interlocked with the PCU. In the event that the motion sensors are activated, the safety interlock will immediately interrupt power distribution from the PCU and notify TRS personnel. Vapor treatment equipment will continue to operate in the event of a motion-sensor alarm.

The security system layout will be provided as part of the final design package when it is completed.

Attachment A

TRS Operational Data Collection Forms

Group A Heater Amps Collection Form						
Date/Time						
Technician						
PCU#						
Tap#						
Voltage						
Current						
Power						
Utility Meter Reading (kWh)	Design Value					
HF7-9						
HF7-8						
HF7-7						
HF7-6						
HF7-5						
HF7-4						
HF7-3						
HF7-2						
HF7-1						
HF8-9						
HF8-8						
HF8-7						
HF8-6						
HF8-5						
HF8-4						
HF8-3						
HF8-2						
HF8-1						
HF9-9						
HF9-8						
HF9-7						
HF9-6						
HF9-5						
HF9-4						
HF9-3						
HF9-2						
HF9-1						
HF10-8						
HF10-7						
HF10-6						
HF10-5						
HF10-4						
HF10-3						

Group A Heater Amps Collection Form						
Date/Time						
Technician						
PCU#						
Tap#						
Voltage						
Current						
Power						
Utility Meter Reading (kWh)	Design Value					
HF10-2						
HF10-1						
HF11-8						
HF11-7						
HF11-6						
HF11-5						
HF11-4						
HF11-3						
HF11-2						
HF11-1						
HF12-7						
HF12-6						
HF12-5						
HF12-4						
HF12-3						
HF12-2						
HF12-1						
HF13-6						
HF13-5						
HF13-4						
HF13-3						
HF13-2						
HF13-1						
HF14-5						
HF14-4						
HF14-3						
HF14-2						
HF14-1						
HF15-4						
HF15-3						
HF15-2						
HF15-1						

Group B Heater Amps Collection Form						
Date/Time						
Technician						
PCU#						
Tap#						
Voltage						
Current						
Power						
Utility Meter Reading (kWh)	Design Value					
HF1-6						
HF1-5						
HF1-4						
HF1-3						
HF1-2						
HF1-1						
HF2-7						
HF2-6						
HF2-5						
HF2-4						
HF2-3						
HF2-2						
HF2-1						
HF3-7						
HF3-6						
HF3-5						
HF3-4						
HF3-3						
HF3-2						
HF3-1						
HF4-7						
HF4-6						
HF4-5						
HF4-4						
HF4-3						
HF4-2						
HF4-1						

Group B Heater Amps Collection Form						
Date/Time						
Technician						
PCU#						
Tap#						
Voltage						
Current						
Power						
Utility Meter Reading (kWh)	Design Value					
HF5-7						
HF5-6						
HF5-5						
HF5-4						
HF5-3						
HF5-2						
HF5-1						
HF6-8						
HF6-7						
HF6-6						
HF6-5						
HF6-4						
HF6-3						
HF6-2						
HF6-1						
HB-58						
HB-59						
HB-60						
HB-61						
HB-62						
HB-63						
HB-64						
HB-65						
HB-66						
HB-67						
HB-68						
HB-69						
HB-70						
HB-71						

Group C Heater Amps Collection Form						
Date/Time						
Technician						
PCU#						
Tap#						
Voltage						
Current						
Power						
Utility Meter Reading (kWh)	Design Value					
HC-1						
HC-2						
HC-3						
HC-4						
HC-5						
HC-6						
HC-7						
HC-8						
HC-9						
HC-10						
HC-11						
HC-12						
HC-13						
HC-14						
HC-15						
HC-16						
HC-17						
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HC-19						
HC-20						
HC-21						
HC-22						
HC-23						
HC-24						
HC-25						
HC-26						
HC-27						
HC-28						
HC-29						
HC-30						

Group C Heater Amps Collection Form						
Date/Time						
Technician						
PCU#						
Tap#						
Voltage						
Current						
Power						
Utility Meter Reading (kWh)	Design Value					
HC-31						
HC-32						
HC-33						
HC-34						
HC-35						
HC-36						
HC-37						
HC-38						
HC-39						
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HC-54						
HC-55						
HC-56						
HC-57						

Temperature and Vapor Point Monitoring Form

Vapor Point Monitoring

	Date				Time				Operator		
	VMP1		VMP2		VMP3		VMP4		VMP5		
	"wc	PID	"wc	PID	"wc	PID	"wc	PID	"wc	PID	
A - 5ft											
B - 15ft											
C - 25ft											
D - 35ft											
E - 45ft											
F - 65ft											
G - 85ft											
H - 105ft											

Temperature Monitoring in the Main Production Area

Temperature Monitoring (°C)

Depth	T-13	T-14	T-15	T-16	T-17	T-18
1 ft bgs						
10 ft bgs						
20 ft bgs						
30 ft bgs						
40 ft bgs						
50 ft bgs						
60 ft bgs						
70 ft bgs						
76 ft bgs						
80 ft bgs						
85 ft bgs						
86 ft bgs						
90 ft bgs						
91 ft bgs						
95 ft bgs						
96 ft bgs						
99 ft bgs						
100 ft bgs						
105 ft bgs						
110 ft bgs						
112 ft bgs						
115 ft bgs						
120 ft bgs						
124 ft bgs						

	Operations Data Collection Form						
	Date/Time						
	Technician						
Computer Data	Condensate PC (gal)						
	Blowdown PC (gal)						
	Make-Up Totalizer (gal)						
	VR Blower Discharge temp PC (C)						
	Ambient PC						
	Utility Meter Reading (kWh)						
Condenser Monitoring	HX Outlet Vacuum ("wc) VG300						
	HX Outlet Vapor Temp (F) TG300						
	Blowdown Totalizer (gal) FT1001						
	Condensate Totalizer (gal)						
	HX Inlet Water Pressure (psi) PG900						
	HX Inlet water temp (C) TG900						
	Digital Diff Pressure ("wc) FIT300						
	Local Makeup Totalizer (gal) FT800						
	HX Outlet Water Pressure (psi) PG500						
	HX Outlet Water temp (C) TG500						
	HX Inlet Vacuum ("wc) VG100						
	HX Inlet Vapor Temp (F) TG100						
	Cooling Water Loop pH						
	Cooling Water Loop TDS						
	Condensate pH						
	Condensate TDS (ppm)						
	Condensate Conductivity (µS/cm)						
	Condensate Temp (˚C)						
	LGAC Influent Pressure (psig)						
	LGAC Mid Pressure (psig)						
	LGAC Effluent Pressure (psig)						
	Cooling Tower Fan On?						
	Cooling Tower Blowdown Activated ?						
	Change/Clean Condensate filter?						
Blower	VR Blower Inlet Vacuum ("H2O)						
	VR Blower Hours						
	Blower Bleed Valve (% Open)						
	VR Blower Discharge temp (F)						
Vapor Monitoring	Group A Effluent PID (ppmv)						
	Group B Effluent PID (ppmv)						
	Group C Effluent PID (ppmv)						
	VGAC Influent PID (ppmv)						
	VGAC Mid PID (ppmv)						
	VGAC Effluent PID (ppmv)						
	VGAC Influent Pressure (psig)						
	VGAC Effluent Pressure (psig)						
	Summa Vapor Sample Collected?						
QA/HS checks	Low Vacuum Interlock Setpoint ("H2O)						
	Groundwater Elevation Checked?						
	Any System Vapor Leaks ?						
	Any System Water Leaks ?						
	TCH Exclusion Zones Secured?						
	Ambient Air PID (ppmv)						
	Indoor Air PID (ppmv)						

Attachment B

TRS Standard Operating Procedures

TRS Accelerating Value	**STANDARD OPERATING PROCEDURE**	**PROCEDURE No: 1.1**

Procedure Title: # Lockout/Tagout (LOTO)

Author:	TRS Team	**Issue Date:**	2/28/09

Revisions:

Date	Initials	Revision Description	Revision #
06/23/09	LS	Add PCU; Changes throughout	1
12/13/10	LS	Update responsibilities: minor language changes; different PCUs	2
11/7/13	TP	Added PCU specific information, and verification steps	3
01/21/16	GK	Split acknowledgement into separate reading and training forms	4
10/12/17	GK	Added PCU specific information, and verification steps	5

Reviewed and Approved by (initial and date):

SOP/ Revision #	Health & Safety		Operations	
Original	05/07/08		05/07/08	
REV 1	07/14/09		07/14/09	
REV 2	12/13/10		12/13/10	
REV 3	11/7/13		11/7/13	
REV 4	1/21/16		01/21/16	
REV 5		10/11/17		10/12/17

1.0 Purpose

This procedure establishes the standard lockout/tagout (LOTO) practices for isolating hazardous energy sources whenever maintenance or servicing is done on machines or equipment at an electrical resistance heating (ERH) site or other sites implementing *in situ* thermal treatment (ISTT) technologies. The procedure details work practices to prevent the unexpected or unintentional energizing or start-up of machines or equipment or release of stored energy increasing the risk of injury. This LOTO procedure is written in accordance with 29 CFR 1910.147, 1926.417 and 1926.702.

2.0 Scope

Only personnel trained to the minimum requirements outlined in **Section 8.1** of this standard operating procedure (SOP) are authorized to conduct LOTO procedures. Authorized personnel are required to perform the lockout in accordance with this procedure. Only personnel who have received training in the National Fire Protection Agency (NFPA) 70E Standard for Electrical Safety in the Workplace are authorized to don arc flash personal protective equipment (PPE) and conduct zero energy verification on opened electrical panels, bus work, or other electrical access points. Arc flash PPE requirements are equipment-specific and are provided on the arc flash warning label on the applicable equipment access panels/doors. Always verify that adequate arc flash PPE is available before proceeding with LOTO procedures.

All TRS personnel and subcontractors working on TRS projects are required to comply with the restrictions and limitations imposed upon them during the use of LOTO. All on-site personnel, upon observing a machine or piece of equipment upon which LOTO has been established to perform servicing or maintenance, shall not attempt to start, energize, or use that machine or equipment. All personnel shall use TRS LOTO devices (locks, tags, isolation equipment) for the purpose of applying LOTO in accordance with these procedures and for no other purpose. This procedure applies to all potential energy sources/hazards. Some examples include:

- Work within electrically conductive portions of the ERH treatment area. To prevent serious injury or death, or damage to equipment when performing ANY intrusive tasks, ALL electrodes are to be de-energized and zero output power must be verified. Intrusive tasks may include work involving electrical power cables, electrode heads, or other conductive portions of the treatment area (and 50 feet surrounding). If there are two or more power control units (PCUs) operating in tandem, **ALL** PCUs must have all electrodes de-energized and power to the field turned off and verified zero energy;
- Construction activities after main disconnect on the PCU is energized;
- Guards to be removed from powered machinery;
- Work that requires entry (or putting hands, head, etc.) into any space where the moving parts of powered machinery are exposed;
- Maintenance or inspection of pressurized vessels, compressed air tanks, or tanks containing high temperature liquids.

If the device being locked out is a plug device (e.g. power tools), LOTO procedures are not required as long as the plug/power supply to that equipment is under the exclusive control of servicing personnel.

The procedures outlined within this document are intended to serve as a guideline for site-specific activities for authorized persons trained per applicable Occupational Safety and Health Administration (OSHA) requirements, proper use of site-specific equipment, potential hazards, and site-specific documents including health and safety plans (HASPs). TRS does not assume responsibility for unauthorized personnel using this document.

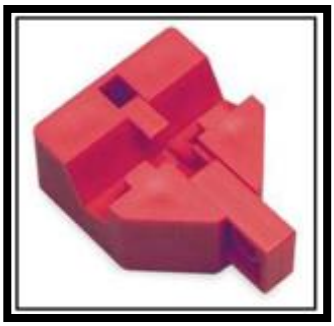
3.0 Definitions

Affected personnel – Any personnel whose job requires him/her to operate or use equipment on which servicing or maintenance is being performed under LOTO, or whose job requires him/her to work in the area in which these activities are being performed. Affected personnel must have received training on proper LOTO work procedures.

Authorized personnel – Any designated personnel who applies lockout or tagout equipment to perform servicing or maintenance. This person must have completed the mandatory LOTO training to be qualified as an authorized person. Only an authorized person installs and removes his or her own lock and tag as required by this SOP.

Energy source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, stored or other energy.

Energy isolating device – Device that prevents the transmission or release of hazardous energy or hazardous materials. For LOTO purposes, isolating devices that provide visible indication of the device's position are desirable. Examples include restraint blocks, electrical circuit breaker toggle lockout device, disconnect switches, slide gates, slip blinds, or line valves.



ERH – Electrical Resistance Heating. ERH is a process whereby soils and groundwater are heated by passing an electrical current through the subsurface volume to be remediated.

Lockout - The placement of a keyed device ("lock") on an energy isolating device, in accordance with this procedure, to prevent the unwanted activation of mechanical or electrical equipment. Lockout ensures the equipment being controlled cannot be operated until the lock is removed.

Tagout - The practice of using tags in conjunction with locks to increase the visibility and awareness that equipment is not to be energized or activated until such devices are removed. Tags cannot be inadvertently or accidentally removed.

Verification – The process of confirming energy has been isolated, a "zero energy" condition exists, e.g. measuring for voltage with a multi-meter or attempting to start a piece of machinery under LOTO.

Medium Voltage – Voltage potential greater than 600 volts alternating current (AC), e.g. 15 kilovolt (kV) switchgear is a medium voltage device.

4.0 Equipment List

- Applicable site-specific design, installation, and safety documents including process flow diagrams (PFDs), electrical schematics, HASPs, Activity Hazard Analysis (AHAs), and Work Plans.
- PPE appropriate for the site. Refer to site-specific HASP.
- Site-Specific LOTO logbook forms and pen (recommend indelible). The logbook form is included as an attachment to this SOP.
- Individual locking device. Pictures of locks used by TRS are included in **Section 6.5**. These locks can **ONLY** be used for the purpose of applying LOTO.
- Tagout device. Tags are generally red in color with wording such as "DANGER-DO NOT OPERATE" and must be able to withstand chemical and weather exposure.

NOTE: Lockout devices and tagout devices shall be singularly identified; shall be the only devices(s) used for controlling energy; shall not be used for other purposes; and shall meet the following requirements as defined by 29 CFR 1910.147(c)(5)(ii): durable, standardized, substantial, and identifiable.

- Device used for attachment of tag. Device must be a non-reusable type, attachable by hand, self-locking, and non-releasable device with a minimum unlocking strength of no less than 50 pounds (equivalent to a one-piece, all environment-tolerant nylon cable tie).
- Snips or similar tool for safe removal of tagout device.
- Digital voltage multi-meter (adequately rated) for energy disruption verification when applying LOTO to a PCU.
- Medium voltage detector (Amprobe) for sensing medium voltage when applicable (i.e. trouble shooting on PCU). Amprobe operation manual is located on SharePoint: Amprobe user manual.

5.0 Lockout/Tagout Procedures

LOTO is performed in accordance with the following sections. Always keep non-essential personnel away from the work area(s) until normal conditions have been established.

5.1 Prepare for Shutdown

1) Prior to commencing LOTO procedures, the Site Health and Safety Officer (SHSO), or their designee, and all on-site TRS staff members must be notified. If there are no TRS personnel on-site, contact the TRS site Project Manager (PM) by telephone. The telephone number for the site contact is posted inside the PCU office or field trailer and is included in the site HASP (a copy of the site HASP is maintained in the PCU office or field trailer).

2) An authorized person must determine which equipment requires LOTO. All operating PCUs must be shut down and LOTO procedures applied if ANY intrusive tasks, including groundwater

sampling, are to be completed within conductive portions of the ERH treatment area (and 50 feet surrounding).

3) If this is an initial LOTO for a piece of equipment or machinery, use the buddy system and approach the situation in a way that minimizes your exposure to hazards. Use the "Hazardous Energy Assessment" form at the end of this SOP to establish the energy hazards associated with the equipment or machinery prior to initiating LOTO.

4) Notify all affected employees that servicing or maintenance is required on a specific machine or equipment or within the ERH treatment area and that the machine or equipment must be shut down and locked out to perform servicing or maintenance. All affected personnel will also apply their LOTO lock to the LOTO box until servicing or maintenance activities are completed.

5) Review the energy isolation verification step for the specific LOTO. Establish a very clear approach to verifying the isolation of energy. Seek assistance from others if the verification approach is not clear or if there is any reason to doubt the correct verification approach is being implemented.

5.2 Shutdown and Isolate

1) The initial LOTO log entry must be made in the project field notes. Note the repair or maintenance being performed. If the project requires a LOTO Logbook, enter the initial LOTO information now in the LOTO Logbook. See Appendix.

2) Shut down all affected machines or equipment in operation using the normal operating controls or shutdown procedures (e.g., depress stop button, open switch, close valve). NOTE: If affected equipment is located within the ERH treatment area, follow LOTO procedures first for the PCU(s) in operation and then for the affected equipment. DO NOT enter the ERH electrode field to complete ANY intrusive work, including LOTO of other equipment, until all electrodes have been de-energized and the PCU(s) have been locked out and tagged out according to this SOP, all residual energy has been dissipated, and voltage testing verifies it is safe to enter.

3) Activate the energy isolating device(s) so that the equipment or machine is isolated from the energy source(s) and apply an approved lock and tag. For example, when tasking involves work on the ancillary equipment panel at an ERH site, use a circuit breaker energy isolating device as shown below to prevent the accidental switch of the circuit breaker to the "on" position.

4) If equipment is to be serviced, unlock the cover to the circuit box and turn off the disconnect switches to the specific equipment being repaired or maintained. Ensure that a disconnect switch,

circuit breaker, valve, or other energy-isolating mechanism is in the SAFE or OFF position. Apply LOTO Devices and approved locks and tags.

5) Lock and tag each energy-isolating device with assigned individual locks.

6) Each authorized individual conducting maintenance or servicing must attach his or her lock and tag to each energy-isolating device.

7) If utilizing energy isolating devices within a circuit box, lock the cover to the circuit box. Each lock comes with only one key. Only the authorized employee who is applying the LOTO to the circuit box cover and performing the intrusive work should secure the key.

8) Attach a weatherproof tag to the lock with tagout device.

9) Record LOTO application in the LOTO logbook (attached to this document). The following information should be recorded in the logbook and maintained on-site with the site-specific HASP:

   a) Name and signature of the individual who shut off the disconnect switches and is performing the maintenance on the equipment;
   b) Equipment/Location of LOTO application;
   c) Explanation of the work performed on the remediation equipment;
   d) Confirmation of notification to affected personnel;
   e) Time and date of lock out; and
   f) Zero energy confirmed by measurement verification step.

6.0 Power Control Unit LOTO Procedures

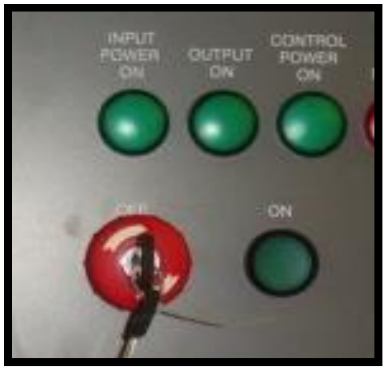
This section will outline the LOTO procedure for each specific model of TRS PCUs.

PCU400 Output Shutdown

a) Request the authorized TRS operator to open contactor via the PCU control computer.

b) Turn the key in the switch labeled "Output Off" to the off position with the button depressed. Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

c) Follow procedures for Tagout as outlined in **Section 5.0**.



d) Don the appropriate arc flash PPE as specified on the arc flash warning label on the PCU output bus panel.

e) Open the output door on exterior of the PCU and maintain a safe distance from the output bus bars.

f) Using a digital multi-meter, measure for voltage between each output bus bar and the bonding/ground terminal in the output cabinet.

PCU400 Input Shutdown

a) Request the authorized TRS operator to open contactor via the PCU control computer.

b) Turn the key in the switch labeled "Output Off" to the off position with the button depressed. Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

c) Open the “Main Disconnect” CB-102 switch located on the main control panel.

d) Follow procedures for Tagout as outlined in **Section 5.0**.

e) Don the appropriate arc flash PPE as specified on the arc flash warning label on the PCU transformer access door.

f) Open the Main enclosure panel and measure for voltage between earth ground and each output or load side of CB-1. The line side of the breakers adjacent to CB-1 can also be used for voltage measurement to earth ground.

PCU500 Output Shutdown

a) Request the authorized TRS operator to open contactor via the PCU control computer.

b) Turn the key in the switch labeled "Output Off" to the off position with the button depressed. Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

c) Follow procedures for Tagout as outlined in **Section 5.0**.

d) Open the output door on exterior of the PCU and maintain a safe distance from the output bus bars.

e) Using a digital multi-meter, measure for voltage between each output bus bar and the bonding/ground terminal in the output cabinet.

PCU500 Input Shutdown

a) Request the authorized TRS operator to open contactor via the PCU control computer.

b) Turn the key in the switch labeled "Output Off" to the off position with the button depressed. Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

c) Follow procedures for Tagout as outlined in **Section 5.0**.

d) Don the appropriate arc flash PPE as specified on the arc flash warning label on the enclosure access panel.

e) Open the enclosure in the control room of the PCU and maintain a safe distance from the electrical components.

f) Using a digital multi-meter, measure for voltage between each output bus bar and the bonding/ground terminal in the output cabinet.

PCU700 Output Shutdown

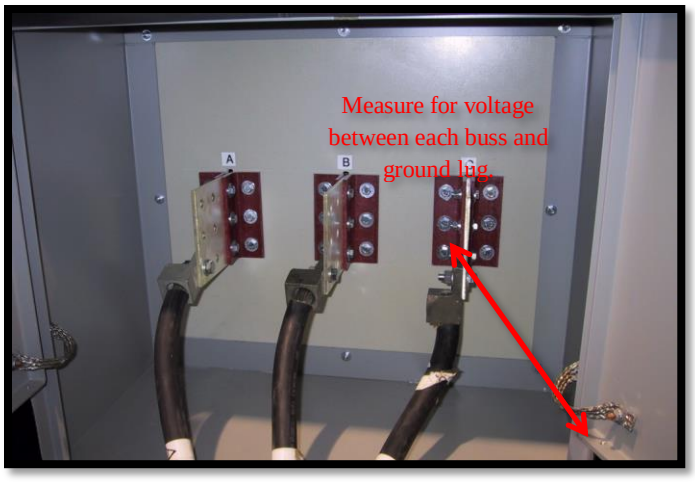
a) Request the authorized TRS person to open contactor via the PCU control computer.

b) Turn the key in the switch labeled "Contactor" to the "Disabled" position. Remove the key and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

c) Follow the procedures for Tagout as outlined in **Section 5.0**.

d) Don the appropriate arc flash PPE as specified on the arc flash warning label on the PCU output bus panel.

e) Open the output door on exterior of the PCU and maintain a safe distance from the output bus bars.



f) Using a digital multi-meter, measure for voltage between each output bus bar and the bonding/ground terminal in the output cabinet.

PCU700 Input Shutdown

a) Request the authorized TRS person to open contactor via the PCU control computer.

b) Turn the "contactor" key to the "Disabled" Position. Remove the key and keep on your person. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

c) Follow procedures for Tagout as outlined in **Section 5.0**.

d) Open the main disconnect 102CB, switch located in the control room.

e) Don the appropriate arc flash PPE as specified on the arc flash warning label on the enclosure access doors.

f) Open the rear PCU enclosure doors. Using the multi-meter, measure for voltage at each input to breakers CB152, CB252, and CB352 to earth ground in the enclosure.

PCU1000 Output Shutdown

a) Prior to initiating LOTO procedures on PCU1000, the TRS operator will need to verify the presence of energy at the test jacks (located in the rear compartment of the PCU, on the side of the panel housing the Main Contactor Circuit Breaker [CB1]). Using a digital multi-meter, first verify multi-meter function (e.g.; testing it on a 120VAC outlet), once the multi-meter is confirmed operational, use the multi-meter to verify voltages on the each of the three pairs of test jacks (P-P): "After Contactor"; L1 to L2, L2 to L3 and L3 to L1. Note the observed readings.

b) The TRS operator will open the main contactor via the PCU control computer or from the local control panel. Non-TRS personnel will request the authorized TRS operator to open the output contactor via the PCU control computer if either locally or remotely.

c) The TRS operator will depress the RED disconnect switch on the electrical control panel in the PCU office. Remove and secure the key from the panel key switch. NOTE: The panel key switch is **NOT** the true LOTO location.

d) Enter the rear compartment of the PCU and locate CB1. Open CB1, remove the key, and secure in the LOTO box. This is the true LOTO location.

e) Use the multi-meter to verify "zero energy" on the each of the three pairs of test jacks (P-P): "After Contactor"; L1 to L2, L2 to L3 and L3 to L1. If "zero energy" is confirmed, proceed onto next steps.

f) Follow the procedures for Tagout as outlined in **Section 5.0**. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

PCU1000 Input Shutdown

a) Using a digital multi-meter, first verify multi-meter function (e.g.; testing it on a 120VAC outlet). Once the multi-meter is confirmed operational, use the multi-meter to verify voltages on the each of the three pairs of test jacks (P-P): "Test Points Input"; L1 to L2, L2 to L3 and L3 to L1. Note the observed readings.

b) The operator will open the main contactor via the PCU control computer or from the local control panel. Non-TRS personnel will request the authorized TRS operator to open the main contactor via the PCU control computer if operating remotely or from the local control panel.

c) The operator will depress the RED disconnect switch on the electrical control panel in the PCU office. Remove and secure the key from the panel key switch. NOTE: The panel key switch is **NOT** the true LOTO location.

d) Locate Circuit Breaker CB100 (it is located to the immediate right of CB1). Open CB100 and place a LOTO lock onto the locking mechanism of CB100.

e) Use the multi-meter to verify voltages on the each of the three pairs of test jacks (P-P): "Test Points Input"; L1 to L2, L2 to L3 and L3 to L1. If "zero energy" is verified, proceed to next steps.

f) Follow the procedures for Tagout as outlined in **Section 5.0**. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

PCU1100 Output Shutdown

a) Prior to initiating LOTO procedures on PCU1100, the TRS operator will need to verify the presence of energy at the test jacks (accessed through an access door at the rear of the PCU). Using a digital multi-meter, first verify multi-meter function (e.g.; testing it on a 120VAC outlet). Once the multi-meter is confirmed operational, use the multi-meter to verify voltages on the each of the three pairs of test jacks (P-P): "Test Jacks" A to B, B to C and C to A. Note the observed readings.

b) The TRS operator will open the main contactor via the PCU control computer or from the local control panel. Non-TRS personnel will request the authorized TRS person to open contactor via the PCU control computer if operating remotely or from the control panel if in local control mode.

c) The PCU1100 does not feature a key switch for the main output contactor. For additional assurance, depress the emergency stop button on the exterior of the PCU by the control room door.

d) Locate the main contactor output disconnect switch (206SW), located directly above the test jacks. Open 206SW, place the LOTO lock on 206SW, and secure the key to the lock in the LOTO box.

e) Using the multi-meter, verify "zero energy" on the each of the three pairs of test jacks (P-P): "Test Jacks" A to B, B to C and C to A. If no voltages are measured proceed to the next step.

f) Follow procedures for Tagout outlined in **Section 5.0**. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

PCU1100 Input Shutdown

a) Using a digital multi-meter, first verify multi-meter function (e.g.; testing it on a 120VAC outlet). Once the multi-meter is confirmed operational, use the multi-meter to verify voltages on the each of the three pairs of test jacks (P-P): "Test Jacks" L1 to L2, L2 to L3 and L3 to L1. Note the observed readings.

b) The TRS operator will open the main contactor via the PCU control computer or from the local control panel. Non-TRS personnel will request the authorized TRS operator to open the main contactor via the PCU control computer if operating remotely or from the local control panel.

c) Locate Circuit Breaker 106CB (it is located directly above 206SW). Open 106CB and place a LOTO lock onto the locking mechanism of 106CB.

d) Use the multi-meter to verify voltages on the each of the three pairs of test jacks (P-P): L1 to L2, L2 to L3, and L3 to L1. If "zero energy" is verified, proceed to next steps.

e) Follow the procedures for Tagout as outlined in **Section 5.0**. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

PCU2000 Output Shutdown

a) Request the authorized TRS operator to open contactor via the PCU control computer if operating remotely or from the control panel if in local control mode.

b) Prior to entering the ERH electrode field to perform ANY tasks, depress the RED disconnect switch on the electrical control panel in the PCU office.

c) Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

d) Follow procedures for Tagout as outlined in **Section 5.0**.

e) Verify energy is isolated and the PCU output is off.

f) Don the appropriate arc flash PPE as specified on the arc flash warning label on the PCU output bus panel.

g) Open the output door on the exterior of the PCU and maintain a safe distance from the output bus bars.

h) Using a digital multi-meter, measure for voltage between each output bus bar and the bonding/ground terminal in the output cabinet.

i) Using the multi-meter, measure for voltage (L-G) between each of the three output bus bars and the ground reference.

PCU2000-5 Output Shutdown

PCU2000-5 is different than the other PCU2000s in the TRS fleet at the time of revising this procedure. An additional medium voltage switch has been added so that the main electrode load can now be electrically isolated without shutting down the vapor treatment system. Eventually, all the TRS PCU2000s will be outfitted in this configuration.

a) Prior to initiating LOTO procedures on this unit, the TRS operator will need to verify the presence of energy at the test jacks (located on the front of the control panel). Using a multi-meter, first verify multi-meter function (e.g.; testing it on a 120VAC outlet). Once verified, use

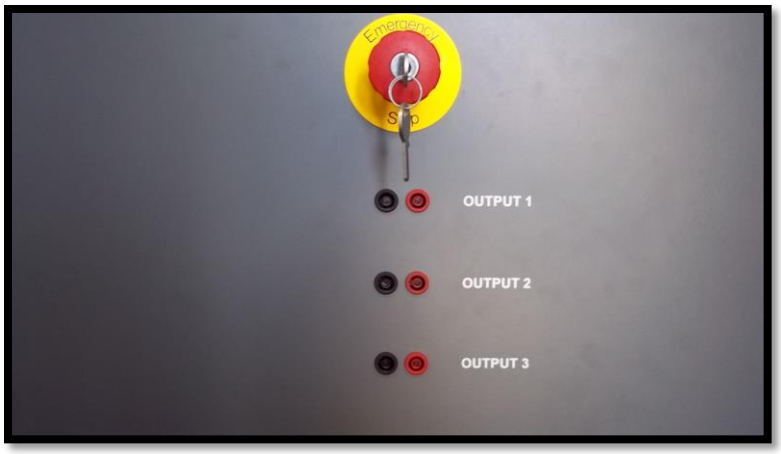
the multi-meter to verify voltages on the each of the three pairs of test jacks. Note the observed readings.

b) The operator will open the main contactor via the PCU control computer or from the local control panel. Non-TRS personnel will request the authorized TRS person to open contactor via the PCU control computer if operating remotely or from the control panel if in local control mode.

c) The operator will depress the RED disconnect switch on the electrical control panel in the PCU office. Remove and secure the key from the panel key switch in a LOTO box with an appropriate lock. NOTE: The panel key switch is NOT the true LOTO location. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

d) Enter the rear compartment on the PCU and locate the main output disconnect switch. Move the switch to the "OPEN" position and lock the switch in the position. This is the true LOTO location. Remove the key and secure it in the LOTO box with an appropriate lock. Follow procedures for Tagout outlined in **Section 5.0**.

e) Verify energy is isolated and the PCU output is off. Verify zero energy by using a digital multi-meter and the test jacks located on the front control panel. Check each of the three (3) pairs of test jacks. Once zero energy is verified proceed with scheduled tasks. Arc flash PPE is not required for zero energy verification due to presence of the output test jacks (see figure below).



PCU2000 Input Shutdown (including PCU2000-5)

a) Request the authorized TRS operator to open contactor via the PCU control computer if operating remotely or from the control panel if in local control mode.

b) Prior to entering the ERH electrode field to perform ANY tasks, depress the RED disconnect switch on the electrical control panel in the PCU office.

c) Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

d) Follow procedures for Tagout as outlined in **Section 5.0**.

e) Open the rear of the PCU enclosure (medium voltage end). Do not enter the medium voltage enclosure containing the switchgear.

f) Open the main 15kV switchgear at the rear of the PCU.

Note: Opening the switchgear removes power downstream (PCU) of the switchgear. The input to the switchgear remains live with medium voltage fed from the electrical utility.

g) Open one of the side access doors to the main enclosure. Without going inside, use the amp trap proximity voltage detector (Amprobe TEC300 Pro) to test for the presence of voltage. Test for

voltage in the 480-volt panel in the rear of the PCU enclosure. **Do not enter the Medium Voltage compartment or main compartment to test for voltage**.

PCU4500 Output Shutdown

a) Request the authorized TRS person to open contactor via the PCU control computer.

b) Prior to entering the ERH electrode field to perform ANY tasks, depress the RED disconnect switch on the electrical control panel in the PCU office.

c) Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

d) Follow procedures for Tagout as outlined in **Section 5.0**.

e) Don the appropriate arc flash PPE as specified on the arc flash warning label on the PCU output bus door.

f) Open the output door and maintain a safe distance from the output bus bars.

g) Using a digital multi-meter, measure for voltage between each output bus bar and the bonding/grounding terminal in the output cabinet.

PCU4500 Input Shutdown

a) Request the authorized TRS operator to open contactor via the PCU control computer if operating remotely or from the control panel if in local control mode.

b) Prior to entering the ERH electrode field to perform ANY tasks, depress the RED disconnect switch on the electrical control panel in the PCU office.

c) Remove and secure the key in a LOTO box with an appropriate lock. If more than one person requires LOTO of the PCU, follow instructions in **Section 6.5** for group LOTO procedures.

d) Follow procedures for Tagout as outlined in **Section 5.0**.

e) Open the main 15kV switchgear at the rear of the PCU.

Note: Opening the switchgear removes power downstream (PCU) of the switchgear. The input to the switchgear remains live with medium voltage fed from the electrical utility

f) Open one of the side access doors to the main enclosure. Without going inside, use the amp trap proximity voltage detector (Amprobe TEC300 Pro) to test for the presence of voltage. Test for voltage in the 480-volt panel in the rear of the PCU enclosure. **Do not enter the Medium Voltage compartment or main compartment to test for voltage**.

6.1 Control Stored Energy

1) All hazardous energy sources will need to be controlled. Ensure the correct piece(s) of equipment is shut down and LOTO applied in accordance with this SOP.
2) Potential energy must also be dissipated or minimized so that injury will not occur if stored energy is released. Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc.) must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down (release of pressure), etc.

3) Use a digital multi-meter to verify electrical energy isolation prior to conducting intrusive work. Where the possibility of induced or stored electrical energy exists, ground the phase conductors or electrical circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground-connecting devices rated for the available fault duty.

6.2 Energy Isolation Verification

Energy isolation verification is a critical part of any LOTO program. The LOTO procedure cannot be fully implemented without completing the verification step.

1) Ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed.
2) Verify the isolation of the equipment by operating the push button or other normal operating control(s) or by testing to make certain the equipment will not operate. Caution: Return operating control(s) to neutral or "off" position after verifying the isolation of the equipment.
3) To create confidence in the verification outcome, a stand-alone or portable instrument is used. For example, verification of voltage on an electrical component would be achieved using a hand-held multi-meter.
4) Use an adequately rated multi-meter to test each phase conductor, or circuit path, to verify they are de-energized. Before and after each test, determine that the voltage detector is operating satisfactorily.
    - Energy isolation verification must be performed at the proper location on each piece of equipment to provide value. A typical LOTO on ERH equipment is to isolate an electrical component such as a PCU. The energy isolation verification locations for the TRS PCUs are described in **Section 6.0**.
    - The PCU2000 and PCU4500 have an input voltage of 12,470 to 13,800 volts and thus require special instruments to measure voltage.

    NOTE: TRS staff will never attempt to directly measure voltage on a medium voltage line or enter a medium voltage enclosure to verify electrical isolation.

5) When isolation verification of a medium voltage service is required, a “proximity” voltage tester is used (following photo). This device allows for the determination of voltage being present or not on a cable or other electrical device without actually touching the electrical device. The device, along with the mounted fiberglass extension handle, allows the person performing the verification to be a safe distance from the measurement location.
6) Document verification of “zero” energy in LOTO logbook.

6.3 Release from LOTO

1) After task completion, the authorized employee shall confirm that all tools and equipment used during LOTO are accounted for and placed in a safe location.
2) If work was conducted within the ERH treatment area, the authorized person will verify that it has been returned to operational condition. The authorized person will conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed.
3) The SHSO and all on-site TRS staff must be notified before removing LOTO devices. If there are no TRS personnel on-site, contact the designated TRS staff member by telephone. The telephone number for the site contact is posted inside the PCU office or field trailer and listed in the site HASP (a copy of the site HASP is maintained in the PCU office or field trailer).
4) Notify affected employees that the lockout devices are ready to be removed. If energizing the ERH area, all personnel must move to safe locations away from the ERH treatment area prior to the removal of LOTO devices. Document in LOTO logbook that these pre-release steps have been completed.
5) Verify all equipment controls are in neutral positions.
6) Remove LOTO devices. The person who attached the LOTO device(s) must remove his own LOTO device(s).
7) Re-energize the machine or equipment. The disconnect switch for the PCU should be turned on by inserting the key and turning it until the switch pops into the “out” position for the 400, 500, 1000, 2000, and 4500 PCUs and the “Control” switch turned to “Enabled” in the 700 PCUs. The authorized TRS operator will then close the contactor via the PCU control computer.
8) Document Date and Time of LOTO removal. Confirm that equipment is functioning properly.

6.4 End of Shift Procedures

If only one shift or individual is to work on the equipment or machine, the attached locks/tags remain in place until maintenance/servicing is complete. If another shift continues the maintenance or service, the authorized individuals from the off-going and on-coming shifts conduct a turnover of the task and associated LOTO. The off-going shift personnel remove their locks and tags, and the on-coming shift personnel install their own locks and tags in accordance with the LOTO procedure.

In the event that team members will not be present at the project site at the same time and there is no ability to manually swap locks at the same time, the original LOTO owner shall place the lockout key in the site's key lockbox (i.e. the lockbox used to store the spare PCU door key and gate access keys). This person shall notify the PM of the equipment lockout and key placement before leaving the site. The new owner shall contact the PM prior to retrieving the key to confirm any changes in status. If there are no changes, the new LOTO owner shall follow the steps to confirm proper LOTO of the equipment and replace the previous LOTO devices with his or her own set.

6.5 Group LOTO

In the event that more than one individual requires the application of LOTO to a piece of equipment, a group lockout procedure may be used. All affected persons are to participate in LOTO procedures including placing a lock on the LOTO box (or other LOTO device). This can be accomplished by having one authorized employee follow normal LOTO procedures and attach his/her lock(s) to the equipment. This authorized employee's keys are then placed into a master LOTO lockbox. Each authorized employee involved in the group LOTO affixes a personal lock to the group lockbox when work begins and removes those devices when work ceases on the machine or equipment being serviced or maintained.

Where service or maintenance must be performed by non-TRS personnel during LOTO, the SHSO and PM will review the project LOTO program with each subcontractor's safety representative during the on-site safety training and inform the authorized and affected employees about any differences in the two companies' procedures that may cause confusion. At a minimum, all requirements of this TRS SOP for LOTO will be followed.

6.6 Multiple PCU LOTO

In instances where multiple PCUs are being operated at a project site, the same procedures should be used as described above for applying LOTO and verifying zero energy for the respective PCUs. It is essential that ALL PCUs have LOTO applied and verified for zero energy before undertaking tasks requiring LOTO. At

no time will activities under LOTO be undertaken with one or more PCUs still in operation on multiple PCU sites.

7.0 Responsibilities

Role	Responsibility
TRS Technical Group Lead	• Develop and implement LOTO program. • Periodically review and update program based on audit findings and project feedback.
TRS Health and Safety Officer (HSO)	• Provide training and maintain documentation. • Reinforce the need to comply with requirements. • Audit the effectiveness of LOTO program.
PM	• Responsible for enforcing LOTO procedures on-site. • Conduct unscheduled field checks on use of LOTO. • Maintain list of Authorized Employees. • Ensure documentation of LOTO is maintained.
SHSO	• Assist in implementation of LOTO on-site. • Conduct orientations for subcontractors and employees. • Coordinate training needs with TRS HSO. • Assist with oversight of LOTO documentation. • Review subcontractor LOTO plan and coordinate efforts.
Authorized Employees	• Comply with LOTO procedure requirements. • Install and remove your own LOTO device(s). • Do not install or remove another person's LOTO device(s).
Affected Employees	• Comply with LOTO procedure requirements. • Do not install or remove another person's LOTO device(s).
Subcontractors	• Comply with LOTO procedure requirements. • Do not install or remove another person's LOTO device(s). • Train subcontractor employees on LOTO procedures.

8.0 Training

Training is an important component of the LOTO program to ensure that employees understand the purpose of the program and to provide employees with the skills and knowledge to perform work safely. Training for affected personnel and authorized employees is provided upon initial assignment and annually thereafter. Additional retraining is provided if there is a change in equipment or procedures or if inadequacies are observed in the individual's application of LOTO procedures. Subcontractors must train their own employees.

Personnel with NFPA 70E Standard for Electrical Safety in the Workplace training are the ***only*** personnel authorized to don arc flash PPE and perform zero energy verification procedures on electrical components.

8.1 Authorized Persons

Authorized persons receive annual training and testing on the purpose and use of the LOTO program. Refresher training is to be provided by the TRS HSO. In addition to this basic training, authorized employees (and in some cases, TRS-authoried subcontractor or client personnel) are trained on-site in the recognition of applicable hazardous energy sources, the type and magnitude of energy available in the workplace, and the methods and means necessary for energy isolation and control. Authorized personnel in LOTO are determined by the ERH PM and must, at a minimum, complete the following requirements:

- Read this LOTO SOP and understand the general LOTO process and the specific requirements of this SOP.
- Complete annual training on the purpose and use of the LOTO program as prescribed by the TRS Health and Safety Officer.
- Obtain on-site instruction by a knowledgeable person on the site-specific hazards related to the control of hazardous energies.
- Be qualified and trained to perform the tasks requiring the use of this procedures.
- Sign the acknowledgement form attached to this SOP.

8.2 Affected Personnel

Affected Personnel receive annual training and testing on the purpose and use of the LOTO program. Affected personnel will receive instructions about how the LOTO procedure works, how it may affect their specific work operations, and the hazards associated with their tasks requiring implementation of LOTO protocol. Refresher training is to be provided by the TRS Health and Safety Officer (or designee)

8.3 Additional Personnel and Site Visitors

All personnel, including site visitors, who are or may be in an area where energy control procedures may be used, will receive site-specific LOTO training during site orientation. Training includes general information about LOTO procedures and about the prohibition relating to attempts to restart or re-energize machines or equipment that is locked out or tagged out.

9.0 Record Keeping

Training and basic knowledge testing documentation of TRS personnel will be maintained by the Technical Group Leader for audit and compliance review purposes, for a minimum of three years following personnel employment. Training documentation of non-TRS personnel will be documented on the attached form and maintained on-site by the TRS PM. A “List of Authorized Personnel” will be maintained by the TRS PM.

The TRS PM also will maintain a record of all LOTO actions for that site in the site PCU office, and updated weekly on the project server site. At a minimum, documentation will include the following information:

- Initial date of Lock-out/Tag-out;
- Description of machinery or equipment being secured;

- Hazard/Malfunction;
- Date that Lock-out/Tag-out Removed;
- Comments (if any).

Hazardous Energy Assessment

Evaluate the equipment for all hazardous potential energy sources and check the left hand box if present. For each, describe the magnitude/type of energy, danger zone (the part(s) of the equipment where the energy is found), and the isolation points. A description on how to control each identified hazardous energy must be described in the procedure

	Types of Energy	Type/Magnitude	Danger Zone	Isolation
	A: Electrical - low voltage (<50 V)			
	B: Electrical- mid voltage (50-600 V)			
	C: Electrical - medium voltage (>600 V)			
	D: Chemical - explosion, pressure, extreme heat, fire, corrosive, reactive, oxidizer, toxic, etc.			
	E: Pressure - hydraulic, pneumatic (> 1 atm)			
	F: Vacuum			
	G: Mechanical - capable of crushing, pinching, cutting, snagging, striking			
	H: Thermal- high temperature-surface temperature (>60°C), hot liquids, steam			
	L: Stored energy - flywheel, springs, differences in elevation, capacitors, batteries, etc.			
	M: Emergency power- does the equipment maintain an emergency power /uninterruptible power supply?			
	N: Other- describe			

SOP 1.1 LOTO Training Acknowledgments

All personnel that receive training on this procedure will review and sign the acknowledgement form contained in this section.

By signing this document, trainee acknowledges that SOP 1.1 LOTO has been read and the contents of the document are understood.

Date	Trainee Name (Print)	Trainee Signature

SOP 1.1 LOTO Training Acknowledgments

I have been trained by TRS Group, Inc. (TRS) to perform lockout and tagout (LOTO) of energized equipment. Trainee has received hands-on training from a competent person who is authorized to use and instruct others on LOTO application at TRS project sites.

Date	Training Acknowledgement Signature	TRS Trainer

Person Applying LOTO	Location of LOTO	Task	Affected persons notified?	Date/Time LOTO Applied	Verified Zero Energy?	Notification of LOTO Removal	Date/Time LOTO Removed	Comments

TRS Accelerating Value	STANDARD OPERATING PROCEDURE	PROCEDURE No: 3.2

Procedure Title:

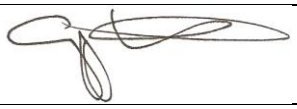
HOT SOIL SAMPLING

Author:	TRS Team	Issue Date:	4/22/08

Revisions:

Date	Initials	Revision Description	Revision #
01-04-10	LS	Add Scope, responsibilities, training, definitions, recordkeeping	1
5-6-14	TP	Added caution concerning hot water, steam expulsion	2
2-22-16	TP	Review, revised power off requirement	3
12-4-17	GK	Removed Geoprobe® Dual-Tube Sampler reference and revised determination for use of Teflon liners.	4
12-02-19	GK	Added section on hot sampling with sonic drill rig	5

Reviewed and Approved by (initial and date):

SOP/ Revision #	Safety & Quality		Engineering	
Original	4/22/08		4/22/08	
REV 1	1/4/10		1/4/10	
REV 2	5/6/14		5/6/14	
REV 3	2/24/16		2/22/16	
REV 4	12/4/17		12/6/17	
REV 5		12/2/2019		12/2/2019

TRS Accelerating Value

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a procedure for the safe collection of representative soil samples during, or after, the application of *in situ* thermal remediation (ISTR) technologies.

2.0 SCOPE

This SOP serves as a guideline for the collection of soil samples during, or after, the application of ISTR. To minimize the risk due to electrical hazards, lockout/tagout (LOTO) procedures must be applied to the ISTR power control unit (PCU) throughout the duration of the soil sampling effort. Only authorized persons trained in procedures and requirements described in SOP 1.1 are permitted to conduct LOTO on TRS equipment. Samples collected using this SOP are generally used for evaluating treatment effectiveness, and/or confirming treatment goals have been met.

TRS Group, Inc. (TRS) personnel shall use this procedure in conjunction with site-specific sample analysis plans and permit requirements. These are standard (i.e., typically applicable) operating procedures, which may be varied or changed as required, dependent on site conditions, equipment limitations, permit requirements, or limitations imposed by the procedure. The ultimate procedures, including any deviations from this SOP, shall be documented in the soil sampling form.

3.0 DEFINITIONS

Authorized Employee

Any designated employee who locks out or tags out equipment to perform servicing or maintenance. This person must have completed the mandatory LOTO training described in SOP 1.1 LOTO to be qualified as an authorized worker. Only an authorized worker installs and removes his or her own lock and tag as required by this program.

Competent Person

Any designated employee who has been trained in proper procedures for the application of ISTR to the subsurface at remediation sites.

ISTR – In Situ Thermal Remediation

A process whereby soil and groundwater are heated to the desired temperature to volatilize the target contaminants. Some ISTR technologies are electrical resistance heating (ERH), thermal conduction heating (TCH), and steam enhanced extraction (SEE).

LOTO – Lockout/Tagout

The practice of using a tag for visibility and awareness in conjunction with placement of a keyed device ("lock") on an energy isolating device, in accordance with SOP 1.1, to prevent the unwanted activation of mechanical or electrical equipment. Lockout ensures the equipment being controlled cannot be operated until the lock is removed.

4.0 EQUIPMENT LIST

1) Soil Sampling Field Form and pen (recommend indelible).
2) Drill rig and related equipment. Soil sampling is best achieved using a direct push drill rig such as a Geoprobe®. Alternative types of drilling methods are hollow stem auger (HSA) or rotosonic (sonic).

3) Ice bath for soil samples. An example is a cooler filled with ice. The cooler (or container) must be equipped with an opening at the bottom to allow water from melting ice to drain.

4) Standard cooking thermometer. Calibrated to both zero (0) degrees Celsius (°C) and 100°C (an infrared thermometer can be substituted when sampling denser soils or bedrock. Keep in mind the sample tube will likely be a few degrees cooler than the internal temperature of the sample).
5) LOTO equipment as described in TRS SOP 1.1.
6) Sample containers, labels, and chain-of-custody forms (as required by the laboratory for the analysis).
7) Safety Glasses with side shields. Additional option: full face-shield (wear over safety glasses).
8) Hearing protection adequate for sampling equipment decibel level. Refer to site-specific Health and Safety Plan (HASP).
9) Latex or nitrile gloves. Additional option: cotton or leather outer gloves (wear over inner latex gloves).
10) Site-specific personal protective equipment (PPE) requirements. Refer to site-specific HASP.
11) Packaging material, chain-of-custody seals, and shipping labels.

5.0 HOT SOIL SAMPLING PROCEDURES

A soil-sampling event begins with the shutdown and application of LOTO to the PCU. This is done to prevent any electrical hazards between the steel drill string and sampling personnel. The vapor recovery system should continue to operate to maintain capture of steam in the subsurface, rather than allowing it to exit through the sample borehole. Interim and final soil sampling is best achieved using a direct push drill rig such as a Geoprobe®. As the probe casing is extracted from the subsurface, it should be considered to be very hot, and handled with proper precaution and personal protective equipment.

Choose a sample sleeve compatible with the conditions being encountered. For example, if the sample location temperature is elevated above 100°C, then a stainless steel sleeve will be a better choice than a Teflon sleeve as the Teflon sleeve will become soft and deform at elevated temperatures. Consult engineering for the appropriate sleeve. Teflon sleeves are only recommended for sampling when expected subsurface temperatures will be at or below 70°C.

Note: sample sleeves can be custom fabricated if supplier inventories are inadequate. Please contact equipment@thermalrs.com if additional resources are needed to procure sampling sleeves.

5.1 Safety Considerations

There are certain hazards associated with the application of ISTR to contaminated soil and groundwater. These hazards include possible contact with hazardous voltages, steam, hot water, hot soil, other hot surfaces, and/or hazardous chemicals. Exposure to these hazards can be mitigated through engineering controls and strict adherence to documented procedures and safety protocols such as the following restrictions:

- The ISTR PCU system must be turned off and LOTO applied during soil sampling activities. Only trained and authorized TRS personnel can perform LOTO of ISTR equipment.
- High temperatures, hot water, and steam may be encountered when collecting subsurface soil samples; the use of the proper PPE is mandatory and caution is advised.
- Contaminant vapors may be present at the borehole during sampling.
- Personnel shall be trained on hazards and engineering controls associated with drilling before beginning sampling operations. Potential hazards include rotating equipment, overhead loads, and slips trips and falls.

Refer to the site-specific Sampling and Analysis Plan (SAP) and HASP for site-specific requirements and restrictions.

Caution: Exposure to hot groundwater and steam possible

The removal of water and soil from the sample borehole can change the temperature/pressure equilibrium conditions existing within the borehole prior to drilling and sampling by reducing the hydrostatic head in the borehole, allowing hot water and steam to eject from the borehole. Review the site conditions prior to commencing drilling or boring. If sampling soil beneath the groundwater surface level elevation, always remove the boring equipment and samples slowly from the boring to allow the borehole conditions to safely re-equilibrate.

Stop and complete the attached Site Sampling Evaluation Checklist before proceeding with this procedure.

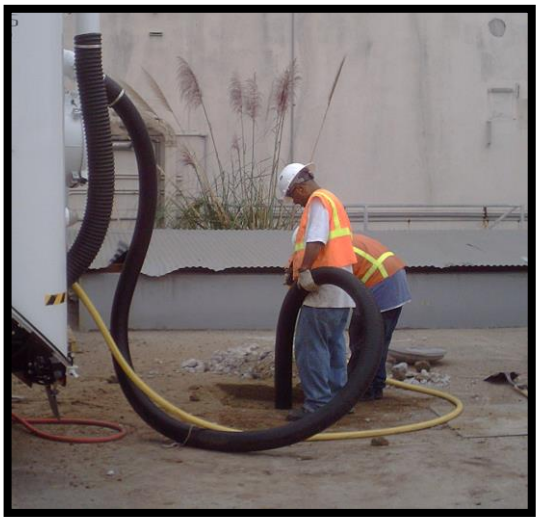
5.2 Hot Soil Sampling Procedures

Whenever possible, sampling shall be completed in order from sample locations having the lowest anticipated concentrations of contaminants of concern (COCs) to locations having the highest anticipated COC concentrations (i.e.; outside treatment area, treatment area boundary, locations within the source area). The steps outlined below must be followed for iterative, interim, and/or final hot soil sampling.

Contact the TRS Project Manager (PM) the day prior to sampling to coordinate a shutdown. A shutdown period of 4 hours is preferred prior to soil sampling.

1) An authorized person shall apply LOTO to the ISTR PCU by site-specific instructions. Note: Only personnel who have been trained and certified by TRS in LOTO procedures can complete this procedure.
2) Position drill rig in the area to be sampled and perform a visual check for any safety concerns. Potential concerns include: high voltage lines, uneven terrain, underground utilities, and egress limitations with rig placement.

3) Hand auger or air knife the first five (5) feet of the boring to clear the location for potential buried utilities.



4) Advance the push sampler to the depth required and collect samples. If subsurface temperatures are expected to be greater than 70°C, the sample sleeves used must be made of brass or stainless steel. Sample sleeves made of acrylic or other materials can melt and bias sample results.

5) The sample sleeves must be capped immediately and placed into the ice bath to begin the cool-down process. Water from melting ice must be allowed to drain, as the sample sleeves should not be submerged at any time.

6) The sample sleeves should be cooled until the soil nears ambient temperature (approximately 20°C or 70 degrees Fahrenheit [°F]). A standard cooking thermometer can be inserted through the end cap for temperature monitoring. The sample sleeve may be opened and sampled once near-ambient temperatures have been reached. Soil samples, including quality control (QC) samples, are collected, labeled, preserved, and shipped per the site-specific SAP.
7) Plugging/sealing of the soil borehole will be in accordance with Federal, State, and/or Local regulatory and client requirements.
8) Soil cuttings not consumed in the sampling process will be disposed of according to Federal, State, and/or Local regulatory and client requirements.

6.0 Hot Soil Sampling Using Rotosonic Method

The procedures for hot soil sampling with a Sonic rig are similar to the steps outlined in **Section 5.2**, except for the following deviations:

- Sonic drilling methods produce large soil cores, 4 to 6 inches in diameter. Cool the cores in a large trough of ice, with drainage of melt water. Ice consumption may range from 500-1,000 pounds per day depending on soil temperature, ambient temperature, and soil core production rate.
- In ambient temperature soil conditions, Sonic drilling methods use a low-density polyethylene (LDPE) sleeve to recover soil cores from the Sonic rig sample apparatus. The LDPE bags used for

this method of sample retrieval are typically only rated for temperatures below 90°C, therefore liners must be used with additional precautions:
    - Cool the exterior of the sonic barrel with a garden hose prior to contact with the LDPE liner and extraction of the soil core. It is recommended to double-bag hot soil cores in the LDPE liners. Have an ice bath ready for immediate cooling of the soil cores.
    - Direct contact with ice below and above the bagged soil core cools the soil cores in approximately 1 hour. Additional plastic may be preferred to further eliminate risk of cross contamination but does slow the cooling rate.
- For sampling at ISTR sites where soil temperatures are greater than 90°C, lexan polycarbonate liners (or equivalent) are an alternative. Lexan polycarbonate is rated to approximately 130°C.
- Some subsurface conditions may make the lexan polycarbonate liners prohibitive.
- Verify with the drilling subcontractor that a second sample core barrel is available to maintain production while the first sample core barrel is cooling and during core extraction.
- Extreme caution will be exercised in cutting the lexan polycarbonate liners when the soil core is ready to be sampled.

7.0 RESPONSIBILITIES

Role	Responsibility
VP Operations	• Develop and implement SOPs • Periodically review and update procedures based on project feedback • Provide training and maintain training documentation
TRS Safety & Quality Manager	• Assist VP Operations with providing training and maintaining training documentation. • Assist Site Health and Safety Officer (SHSO) with modifying SOP to meet site-specific HASP requirements.
PM	• Review procedures in conjunction with site-specific sample requirements and scope of work (SOW). Coordinate changes to procedures as necessary. • Schedule and coordinate sampling effort. Ensure adequate supplies are available.
SHSO	• Conduct orientations for subcontractors and employees • Coordinate training needs with TRS SQM • Review procedures in conjunction with site-specific HASP. Coordinate changes to procedures as necessary to maintain safe working procedures.
Sampling Personnel	• Complete training to the level of competent person prior to initiating sampling activities. • Follow procedures and document information related to soil sampling effort as identified in this SOP, including and deviations from the SOP.

8.0 TRAINING

Training in SOPs is provided upon initial assignment and annually thereafter. Additional retraining is provided if there is a change in procedures or if inadequacies are observed in the individual's application of procedures. Subcontractors must train their own employees. LOTO training requirements for personnel are outlined in SOP 1.1.

9.0 RECORD KEEPING

These are standard (i.e., typically applicable) procedures, which may be varied or changed as required dependent on site conditions, equipment limitations, permit requirements, or limitations imposed by the procedure. The ultimate procedures used during any sampling event, including any deviations from these procedures, shall be documented in the sample logbook.

At a minimum, the following information shall be maintained in the sample logbook related to hot soil sampling at ISTR sites:

- Date
- Sample identification and corresponding location
- Sample time
- Sample identifications and analysis to be performed
- Chain-of-custody number
- Shipping information
- Deviations from this SOP
- Any other information deemed relevant to the sample results

Copies of chain-of-custody forms and shipping documentation shall be maintained and kept with the sample logbook.

10.0 REFERENCES

TRS Group, Inc., 2013. SOP 1.1, Lockout/Tagout (LOTO), Most Recent Version.

US EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846,

Most Recent Version (Method 5035)

SOP 3.2 Hot Soil Sampling

Training Acknowledgment

All personnel that receive training on this procedure will review and sign the acknowledgement form contained in this section.

I have been trained by TRS Group, Inc. (TRS) to perform hot soil sampling at TRS ISTR project sites. By signing this document, trainee acknowledges that SOP 3.2 Hot Soil Sampling has been read and the contents of the document are understood. Trainee has received hands-on training from a competent person who is authorized to use and instruct others on sampling procedures at TRS project sites.

Date	Trainee (print)	Trainee (Sign)	Trainer

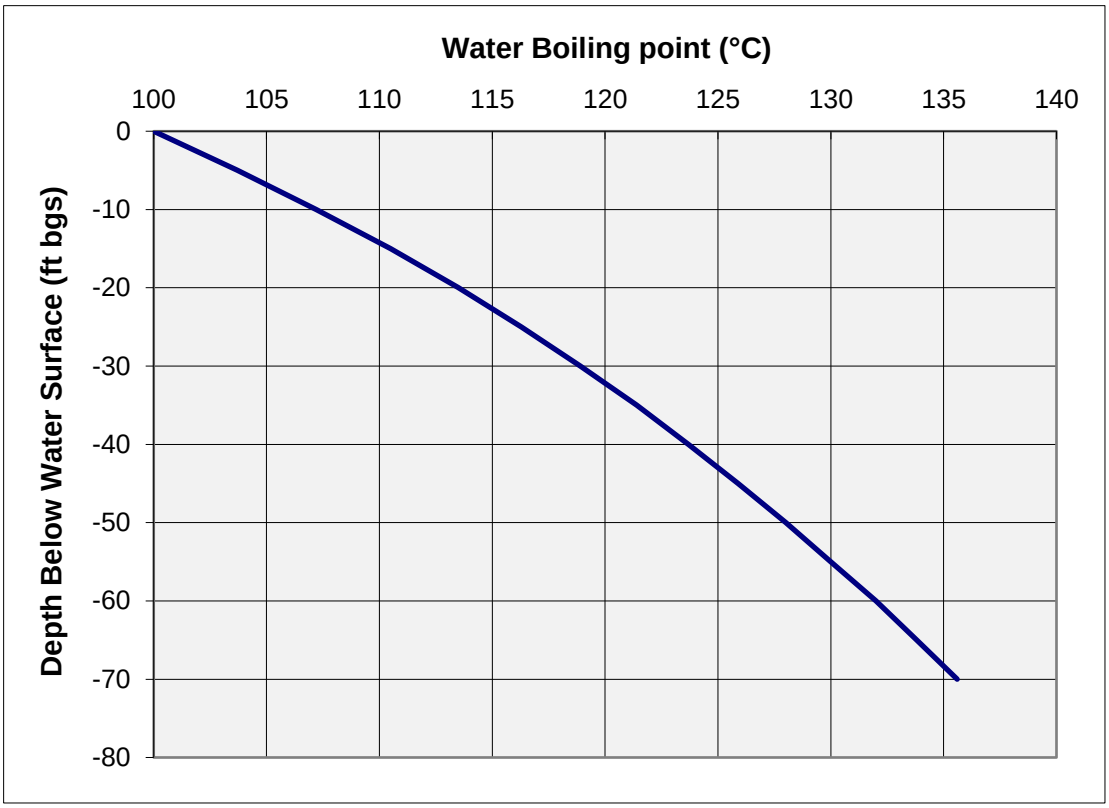
Site Sampling Evaluation Checklist

Project #: _____

Date: _____

Subsurface Conditions

1) Are soil samples being recovered from beneath the groundwater surface?
2) What is the depth to groundwater at the time of sampling?
3) How deep below the groundwater surface elevation are we sampling?
4) What are the current temperatures at or near each boring location?
5) Are there confining layers on site? Clay or silt over saturated zone sand for example.
6) Use the figure below to determine where the sites actual temperatures fit on the boiling point curve.



7) Actual temperature for each depth elevation that is higher in value than the temperatures represented by this curve suggest a temperature value greater than the hydrostatic boiling point of water.

TRS Accelerating Value	**STANDARD OPERATING PROCEDURE**	**PROCEDURE No: 3.3**

Procedure Title: # Vapor Sampling Post-Condenser

Author:	TRS Team	**Issue Date:**	

Revisions:

Date	Initials	Revision Description	Revision #
12-01-05	GK	Additional changes to make specific to ERH	1
07-15-09	LS	Update procedures and format	2
6-14-16	JL/TP	Update procedure to include all types of vapor sampling	3

Reviewed and Approved by (initial and date):

SOP/ Revision #	Health & Safety		Operations	
Original		10/04/05		10/04/05
Rev1		12/01/05		12/01/05
Rev2		7/15/09		7/15/09
Rev3		6/15/16		6/15/16

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide uniform procedures for the safe collection of representative samples from the vapor treatment system(s) associated with electrical resistance heating (ERH) operations.

2.0 SCOPE

This SOP serves as a guideline for the collection of vapor samples during the application of ERH from discrete locations of the (VR) vapor recovery and treatment system. There are two categories of vapor sample collection locations: **pre-condenser,** and **post-condenser**. **Pre-condenser** locations are those situated between the electrodes and the inlet to the condenser(s) used to remove steam from the recovered vapor stream. These locations will be under vacuum. Vapor sample locations in the pre-condenser location may include: multi-phase extraction (MPE) wells, vapor recovery headers, electrode heads, or other site-specific locations. **Post-condenser** locations will generally be associated with the vapor abatement equipment, and are located between the condenser vapor outlet and the abatement equipment. These locations will generally be under positive pressure. Vapor sample locations in the post-condenser location may include: prior to, between and after granular activated carbon (GAC) vessels, prior to and after a thermal or catalytic treatment unit, or other site-specific locations.

Vapor samples may be collected in either Tedlar® bags, or SUMMA® canisters. Samples collected under this procedure may be used for calculating mass removal rates, performance monitoring, compliance monitoring, or monitoring treatment media loading to prevent "breakthrough".

TRS Group, Inc. (TRS) personnel will use this procedure in conjunction with site-specific sample analysis plans, discharge permit requirements, and Health and Safety Plans (HASP). These are standard (i.e., typically applicable) operating procedures which may be varied, or changed as required, dependent on site conditions, equipment limitations, permit requirements, or limitations imposed by the procedure. The site-specific procedures, including any deviations from this SOP, will be documented in the site-specific sampling plan and field notes.

Vapor samples typically will be collected from the equipment compound during normal ERH operations, with energy application being applied to the electrodes and the VR system at a normal flow rate. Lockout/Tagout (LOTO) procedures, therefore, in most cases will not be required for this task. Please refer to the site-specific HASP and consult with the project manager (PM) and Site Health and Safety Officer (SHSO) for site-specific requirements and restrictions.

3.0 DEFINITIONS

Authorized employee – Any designated employee who locks out or tags out equipment in order to perform servicing or maintenance. This person must have completed the mandatory LOTO training described in SOP 1.1 LOTO to be qualified as an authorized worker. Only an authorized worker installs and removes his or her own lock and tag as required by this program.

Competent Person – Any designated employee who has been trained in proper procedures for the application of energy to the subsurface at ERH sites. This person must have completed the mandatory training outlined in **Section 7.0** to be qualified as a competent person.

ERH – Electrical Resistance Heating. ERH is a process whereby soils and groundwater are heated by passing an electrical current through the subsurface volume to be remediated.

External Filter – Small filters, also referred to as a "water trap", that attach to the end of a photoionization detector (PID) to filter out small dust particles and water droplets. These filters are required when using a PID to analyze vapor samples collected from and ERH system. RAE Systems part number is 008-3022-010.

Flame Ionization Detector (FID) – A direct-read instrument that uses a hydrogen flame instead of an ultraviolet (UV) light source to detect hydrocarbons. The FID will detect straight-chain hydrocarbons (methane, octane, ethanol, etc.), much better than a PID, including a wide array of non-target organic compounds. A FID is less effective than a PID at detecting chlorinated hydrocarbons.

Grab Sample – A single sample or measurement taken at a specific time and location or over as short a period as feasible at a specific location.

Humidity Filtering – A filter system that can be used in addition to the external filter to remove excess moisture during PID screening. Humidity filtering may be used when PID screening results indicate moisture interference. Refer to Mini-Rae Technical Note TN-178. RAE Systems part numbers are 025- 2002-010 (make sure to get the one applicable for VOC sampling), 025-3002-000, and 411-0005-000. TN-178 is provided at the end of this document.

LOTO – Lockout/Tagout. The practice of using a tag for visibility and awareness in conjunction with placement of a keyed device ("lock") on an energy isolating device, in accordance with SOP 1.1, to prevent the unwanted activation of mechanical or electrical equipment. Lockout ensures the equipment being controlled cannot be operated until the lock is removed.

MPE – Multi-Phase Extraction wells. These wells are designed to recover both liquids and vapors from the sub-surface.

PID – Photoionization Detector. Direct-read instrument that detects total concentrations of many organic and some inorganic gases and vapors. A PID ionizes molecules using UV radiation which produces a current that is proportional to the number of ions present. PID limitations include:

- Does not detect methane;
- Does not detect a compound if the PID bulb emits a lower energy level than the compound's ionization potential;
- Meter response may change when gases are mixed;
- Other voltage sources may interfere with measurements;
- Readings can only be reported relative to the calibration standard used; and
- Response is affected by high humidity.

Pre-Condenser Sample Locations – Sampling points located between the electrodes and the inlet to the condenser(s) used to remove steam from the recovered vapor stream. These locations will be under vacuum. Vapor sample locations in the pre-condenser area may include: MPE wells, vapor recovery headers, electrode heads, or other site-specific locations.

Post-Condenser Sample Locations – Sampling points generally associated with the vapor abatement equipment, which are located between the condenser vapor outlet and the abatement equipment.

These locations will generally be under positive pressure. Vapor sample locations in the post condenser area may include: prior to, between and after GAC vessels, prior to and after a thermal or catalytic treatment unit, or other site-specific locations.

Summa® Canister – A stainless steel sampling canister evacuated to -30 inches mercury ("Hg) that is used to collect an instantaneous air sample for analysis by a laboratory. Canisters require no pump calibration and are designed to prevent permeation of volatile organic compounds (VOCs) through the vessel wall and VOC degradation due to exposure to sunlight. Generally, smaller canisters are used for higher concentrations.

Tedlar® Bag – A sample bag made from polyvinyl fluoride (PVF) that is tough, durable, and chemically inert to a wide range of chemicals. They have a working temperature range of 98 to 225 degrees Fahrenheit (°F). They are not recommended for reactive compounds and compounds that may adhere to the bag surface. The holding time for samples collected in these bags is between 24 and 72 hours dependent upon the compounds sampled. These bags can be reused if the concentrations are in the parts per billion by volume (ppbv) range and are thoroughly flushed with nitrogen gas between uses.

Time-weighted-average (TWA) sample – Sample collected from a particular location over a specific span of time. A settable flow controller is used to collect a sample over a pre-determined span of time that generally ranges from 40 minutes to 24 hours. TWA samples are sometimes referred to as time integrated samples.

Treatment Unit- As used in this procedure, a treatment unit may be GAC, a thermal oxidizer (therm-ox), catalytic oxidizer (cat-ox) or a steam regenerated thermal oxidizer (steam regen) or steam regenerated carbon systems.

Vacuum Desiccator – A desiccator equipped with a stopcock whereby it can be evacuated. It also may be referred to as "vacuum box" or "lung sampler".

VR – Vacuum Recovery. For purposes of this SOP, VR includes all of the piping and headers used to convey steam and recovered contaminant vapors from the sub-surface to the vapor treatment train.

4.0 EQUIPMENT LIST – Pre and Post Condenser Locations

The equipment outlined in **Section 4.1** and **Section 4.2** is required when collecting a vapor sample from anywhere within the vapor recovery and treatment system.

4.1 PID Sampling

1) Vapor Sampling Field Form and indelible ink pen.
2) Safety Glasses with side shields (American National Safety Institute Z87.1-2003).
3) Latex, or Nitrile gloves.
4) Half-face respirator (optional or may be required, refer to site-specific Health and Safety Plan (HASP)).
5) Site-specific PPE requirements. Refer to site-specific HASP.
6) PID (or FID).
7) 0.5 Liter (L) or 1L Tedlar® bag dedicated to each sample location.
8) Battery operated 12-volt Sample pump (capable of 10" Hg).
9) 12-volt automotive battery (or similar).
10) Disposable Tygon® or Masterflex® tubing (or similar).
11) Humidity filter tubes, tube adapter, and tubing connection (optional).
12) Scissors (for cutting tubing lengths).

4.2 Summa Canister Samples

In addition to items identified in **Section 4.1**, sampling with a Summa® canister requires the following items:

1) 9/16 inch crescent wrench.
2) Vacuum gauge reading 0 to 30" Hg.
3) Summa® canister with sample label for each sample location.
4) Particulate filter.
5) Chain-of-custody form(s).
6) Packaging material and shipping labels

5.0 VAPOR SAMPLING PROCEDURES

This section outlines the procedures for the collection of vapor samples from locations (or ports) identified as pre-, interim, and post- vapor treatment. To ensure operator safety and the collection of representative vapor samples, sampling personnel will follow these guidelines:

5.1 Safety Considerations

- **At no time will a 110/120 volt extension cord from a power source be used in an energized electrode field.** An alternative power source such as a 12-volt automotive battery or portable generator must be used when samples are collected in the proximity of ERH electrode supply cables when power is applied to the treatment area.

- Review sampling plan and determine if LOTO of any device(s) is/are required. If required, verify and review all LOTO that has been applied prior to performing vapor sampling. If LOTO is not present or insufficient, apply additional LOTO as necessary in accordance with TRS SOP 1-1 Lockout/Tagout.

- Verify that electrodes are energized and the VR system is operating normally prior to collecting vapor samples. Electrodes should have power applied in order to provide accurate and representative operational data.

- Sampling will be completed in order of lowest anticipated VOC concentrations to highest anticipated concentrations (typically post, interim, and then pre-treatment locations).

5.2 Post-Condenser Sample Collection

Vapor samples collected from a post-condenser location (e.g., between the condenser and the treatment system) are used to monitor the influent concentration. The influent concentration along with manifold temperature, pressure and flow can be used to calculate the current, and cumulative contaminant mass recovered from the treatment area. Vapor samples collected at interim locations (e.g., between treatment units) are used to calculate treatment media loading to monitor for contaminant breakthrough. Vapor

samples collected from a post-treatment sample location (e.g., after treatment and immediately prior to discharge) are used to monitor the effectiveness of the vapor treatment technology and for compliance reporting that may be required by a site air discharge permit.

5.2.1 PID (or FID) Sampling

At a minimum, the PID (or FID) will be field calibrated according to manufacturer's recommendations using a calibration gas. Documentation of field calibration and calibration check result will be maintained on the vapor sampling form.

A standard calibration gas, typically 100 parts per million (ppm) isobutylene, will be used for PID calibration. Readings collected through field screening with the PID can be adjusted by using VOC Correction Factors (CFs) for individual known contaminants of concern (COCs). These correction factors have been provided in Mini-RAE Technical Note TN-106. For example, if you are analyzing a vapor stream laden with TCE, the isobutylene calibrated PID reading of 100 ppm, is really 54 ppm. TN-106 is provided at the end of this document.

5.2.2 Sample locations under positive pressure

This subsection details the specific procedures for collecting a sample with a Tedlar® bag for analysis with a PID from a sample location under positive pressure.

1) Don appropriate sampling PPE (see **Sections 4.1** and **4.3**)
2) Document system flow readings prior to collecting any vapor samples.
3) Confirm that the PID lamp size is appropriate for the target VOCs.
4) Attach the external filter (water trap) and tubing to the PID.
5) Connect the flexible connection tubing to the barb on the sample valve and open for 10 seconds to purge the ambient air from the tubing. Ensure that the tubing makes a tight seal with the barb.
6) With the sample valve closed, connect the deflated Tedlar® bag and open the bag valve (no more than 1 turn).
7) Open the sample valve and fill the Tedlar® bag until it is 80 percent full. **CAUTION:** Over filling of the bag will cause it to burst.
8) Purge the bag contents and repeat steps 4 through 6. This will ensure a representative sample is collected. If humidity filtering is being completed, connect the filter according to the manufacturer's instructions when collecting the final bag prior to screening with the PID.
9) Close the sample valve and the bag valve.
10) Remove the flexible tubing and bag from the sample barb (and humidity filter if being used). Insert the sample tip of the calibrated PID (or FID) into the end of the tubing.
11) Open bag valve no more than one turn and allow the PID (or FID) to extract and analyze the vapors out of the bag.
12) Monitor concentrations displayed on the PID (or FID) screen until a stable number is observed.

13) Record the data with time, date, and vapor stream flow rate in sample logbooks.

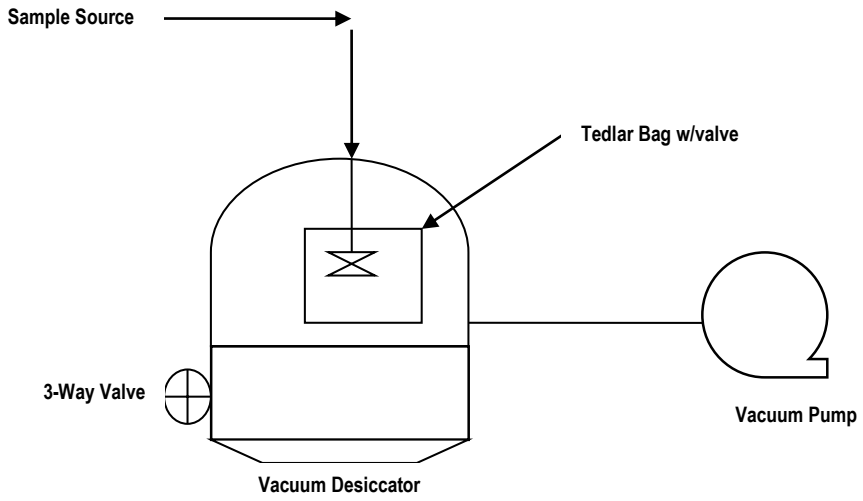
5.2.3 Sample locations under negative pressure collected with a vacuum desiccator

The following procedure describes the collection of a grab sample under negative pressure using a vacuum pump and desiccator. The use of a vacuum desiccator will eliminate the risk of cross-contamination between the vapor sample and the sample pump. Use PPE as noted in **Section 4.1** and follow requirements of the site-specific HASP.

The desiccator acts as an airtight chamber. The Tedlar® bag is placed in the vacuum desiccator and attached to a barbed fitting that runs through the wall of the vacuum desiccator. The air is then evacuated from the vacuum desiccator causing the bag to fill. The sample never makes contact with the pump and thus avoids any potential cross-contamination.

The following sequential steps will be followed to collect grab vapor samples in Tedlar® bags using a vacuum desiccator.

1) Document system flow readings:
2) Confirm that the PID lamp size is appropriate for the target VOCs.
3) Attach external filter (water trap) and tubing to the PID.
4) Attach tubing to sample port. Ensure that the tube to barb connections are tight. Leaky connections will negatively impact the sample collection.
5) Attach the other end of tubing to the inlet of the vacuum desiccator. Label a new Tedlar® bag with sample identification (e.g., location, time, and date) before filling. Open the vacuum desiccator and insert the Tedlar® bag into the through-fitting. Open the valve on the Tedlar® bag. Close the vacuum desiccator. Attach a piece of tubing from the outlet of the vacuum desiccator to the inlet of the vacuum pump. See the figure below for a typical vacuum desiccator set-up.



6) Open the sample port valve. Turn on the vacuum pump. Close the stopcock on the vacuum desiccator. As the air is evacuated from the vacuum desiccator, the Tedlar® bag will begin to fill with sample vapors. Once the bag is about 2/3 full, close the sample port valve. Turn off the vacuum pump. Slowly open the three-way valve on the vacuum desiccator to release the vacuum. Open the vacuum desiccator, close the valve on the Tedlar® bag and then remove the bag from the desiccator with the flexible tubing attached. Caution shall be used to not over fill, which can happen quickly, as this will cause the Tedlar ® bag to break.

7) Open the sample port valve, and allow the vacuum from the vapor system to empty the bag.

8) Repeat steps 6 and 7 three times to assure a representative sample has been collected. If using the humidity filtration system, attach the filter according to manufacturer's recommendations prior to completing final fill of Tedlar® bag.

9) Insert the sample tip of the calibrated PID (or FID) into the flexible tubing attached to the Tedlar® bag.

10) Open bag valve no more than one turn and allow the PID (or FID) to extract and analyze the vapors from the bag.

11) Monitor concentrations displayed on the PID (or FID) screen until a stable number is observed.

12) Record the data with time, date, and vapor stream flow rate in vapor sampling forms.

5.2.4 Summa Canister Sampling

Summa canister sampling procedures will be the same at post-, interim, and pre-vapor treatment sample locations. Although the VR header will be under vacuum at the pre-treatment location, the Summa® vacuum will be greater than the header vacuum. This will generally allow for the collection of an adequate volume of sample for analysis.

Prior to collecting a vapor sample with a Summa® canister for offsite analysis, document system flow readings and collect a vapor sample into a Tedlar® bag. Use a calibrated PID equipped with an appropriate electron volt (eV) lamp to analyze the sample collected in the Tedlar® bag.

Samples collected for offsite laboratory analysis will use the method appropriate to, or required by, the site air discharge permit. All samples will be analyzed on a turnaround time (TAT) compliant with project protocols. Duplicate Summa® canister samples should generally be collected and analyzed with a 10 percent frequency, or as required by the site-specific requirements.

5.2.4.1 Grab summa sample

Prior to collecting a vapor sample with a Summa® canister, verify and record the vacuum of the canister with a vacuum gauge. Summa® canisters should have a vacuum of at least 25" Hg when deployed. Any vacuum less than 25" Hg indicates a possible leak. The Summa® canister must be replaced with one that has an adequate vacuum.

1) After the Summa® canister vacuum has been verified and recorded, attach a particulate filter (supplied by the laboratory) to the canister valve.

2) Connect the Summa® valve to the sample valve using stainless steel tubing and compression fittings. These fittings may be provided by the laboratory, if not obtain a list of the required fittings form the laboratory. If none are available or in place, notify the TRS Project Manager immediately. Do not attempt to use a compression fitting as a hose barb. This will lead to leaks and unrepresentative data.

3) Open the sample valve fully then slowly open the Summa® valve until the movement or air into the canister cannot be detected by auditory means.

4) Wait 60 seconds and close the Summa® and sample valves. Do not over tighten the canister valve.

5) Disconnect the conveyance tubing and remove the particulate filter and verify and record any remaining vacuum in the canister.

6) Once the remaining vacuum has been recorded, replace the Swagelok® cap on the canister and tighten with the wrench. Do not over-tighten cap.

7) Attach a completed sample label (hang tag type) to the canister (**No stickers**).

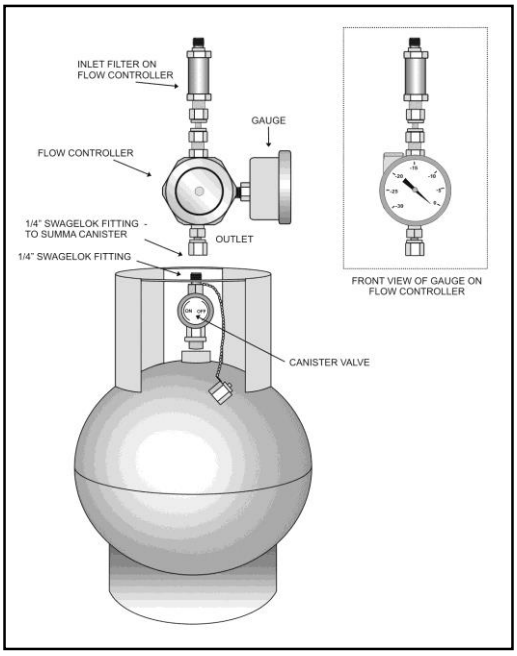
8) All pertinent information will be documented in the sample log book and sample COC forms including: date, sample time, flow rate, serial number on canister, serial number of the gauge, starting and final pressures of the canister, sample identification, and any other information deemed relevant to the sample results.

9) The Summa® canister will then be expedited to the offsite laboratory for analysis, requesting the appropriate TAT.

5.2.4.2 TWA summa sample

Prior to collecting a vapor sample with a Summa® canister, verify and record the vacuum of the canister with a vacuum gauge. Summa® canisters should have a vacuum of at least 25" Hg when deployed. Any vacuum less than 25" Hg indicates a possible leak. The canister must be replaced with one that has adequate vacuum.

1) After the Summa® canister vacuum has been verified and recorded, attach the laboratory calibrated flow controller as indicated in the drawing below and particulate filter (if supplied by the laboratory) to the canister valve.



2) Connect the inlet of the flow controller assembly to the sample valve using stainless steel tubing and compression fittings. These fittings may be provided by the laboratory, if not obtain a list of the required fittings form the laboratory. If none are available or in place, notify the TRS Project Manager immediately. Do not attempt to use a compression fitting as a hose barb. This will lead to leaks and unrepresentative data.

3) To begin the sampling, open the sample valve first, then open the valve on the canister fully. The flow controller has been calibrated in the laboratory to deliver the correct volume in the selected sampling time period.

4) At the end of the sampling time period, close the valve to the Summa® canister. Do not over tighten the valve. Record the sampling time on the chain-of-custody; along with the identification number for the canister.

5) After the valve is closed, remove the passive flow controller then verify and record any remaining vacuum in the canister.

6) Replace the Swagelok® cap on the canister and tighten it with a wrench.

7) Attach a completed sample label (hang tag type) to the canister. Do not attach stickers to the canister.

8) All pertinent information will be documented in the sample log book and sample chain of custody forms including: date, sample time interval, flow rate, serial number on canister, serial number of the gauge, starting and final pressures of the canister, sample identification, and any other information deemed relevant to the sample results.

9) The Summa® canister will then be expedited to the offsite laboratory for analysis, requesting the appropriate TAT.

6.0 RESPONSIBILITIES

Role	Responsibility
VP Operations	• Develop and implement SOPs. • Periodically review and update procedures based on project feedback.
TRS Health and Safety Officer (HSO)	• Provide training and maintain documentation. • Coordinate training for site personnel performing procedures. • Review and update this SOP and associated AHAs periodically.
PM	• Review procedures in conjunction with site specific sample requirements and air permit requirements. Coordinate changes to procedures as necessary. • Schedule and coordinate vapor sampling efforts. Ensure adequate supplies are available.
SHSO	• Conduct orientations for subcontractors and employees. • Coordinate training needs with TRS HSO. • Review procedures in conjunction with site specific HASP. Coordinate changes to procedures as necessary to maintain safe working procedures.
Sampling Personnel	• Follow procedures and document information related to vapor sampling effort as identified in this SOP, including and deviations from the SOP.

7.0 TRAINING

Training in SOPs is provided upon initial assignment and annually thereafter. Additional retraining is provided if there is a change in procedures or if inadequacies are observed in the individual's application of procedures. Subcontractors must train their own employees.

8.0 RECORD KEEPING

These are standard (i.e., typically applicable) procedures which may be varied or changed as required, dependent on site conditions, equipment limitations, permit requirements, or limitations imposed by the procedure. The ultimate procedures used during any sampling event, including any deviations from these procedures, will be documented in the sample logbook.

PID calibrations will be completed according to manufacturer's recommendations. PID readings of the influent vapor should be collected daily, or as dictated by project requirements, when personnel are on site. PID calibration measurements and readings will be maintained on vapor sampling forms and kept at the site throughout the operational phase of the project.

At a minimum, the following information will be maintained in the sample logbook related to Summa® canister collection: date, sample time (or sample range of time for TWA samples), flow rate, PID reading recorded prior to sample collection, serial number on canister, serial number of the gauge, starting and final pressures of the canister, sample identification, chain of custody number, and any other information deemed relevant to the sample results. Copies of COC forms and shipping documentation will be maintained and kept with the sample logbook.

SOP 3.3 Vapor Sampling Training Acknowledgments

All personnel that receive training on this procedure will review and sign the acknowledgement form contained in this section.

I have been trained by TRS Group, Inc. (TRS) to perform sampling of vapor that is not steam-laden. By signing this document, trainee acknowledges that **SOP 3.3 Vapor Sampling** has been read and the contents of the document are understood. Trainee has received hands-on training from a competent person who is authorized to use and instruct others on sampling procedures at TRS project sites.

Date	Training Acknowledgement	TRS Trainer

A GUIDELINE FOR PID INSTRUMENT RESPONSE

CORRECTION FACTORS AND IONIZATION ENERGIES*

RAE Systems PIDs can be used for the detection of a wide variety of gases that exhibit different responses. In general, any compound with ionization energy (IE) lower than that of the lamp photons can be measured.* The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. In our PIDs, correction factors can be used in one of three ways:

1. Calibrate the monitor with isobutylene in the usual fashion to read in isobutylene equivalents. Manually multiply the reading by the correction factor (CF) to obtain the concentration of the gas being measured.
2. Calibrate the unit with isobutylene in the usual fashion to read in isobutylene equivalents. Call up the correction factor from the instrument memory or download it from a personal computer and then call it up. The monitor will then read directly in units of the gas of interest.
3. Calibrate the unit with isobutylene, but input an equivalent, "corrected" span gas concentration when prompted for this value. The unit will then read directly in units of the gas of interest.

** The term "ionization energy" is more scientifically correct and replaces the old term "ionization potential." High-boiling ("heavy") compounds may not vaporize enough to give a response even when their ionization energies are below the lamp photon energy. Some inorganic compounds like H_2O_2 and NO_2 give weak response even when their ionization energies are well below the lamp photon energy.*

Example 1:

With the unit calibrated to read isobutylene equivalents, the reading is 10 ppm with a 10.6 eV lamp. The gas being measured is butyl acetate, which has a correction factor of 2.6. Multiplying 10 by 2.6 gives an adjusted butyl acetate value of 26 ppm. Similarly, if the gas being measured were trichloroethylene (CF = 0.54), the adjusted value with a 10 ppm reading would be 5.4 ppm.

Example 2:

With the unit calibrated to read isobutylene equivalents, the reading is 100 ppm with a 10.6 eV lamp. The gas measured is m-xylene (CF = 0.43). After downloading this factor, the unit should read about 43 ppm when exposed to the same gas, and thus read directly in m-xylene values.

Example 3:

The desired gas to measure is ethylene dichloride (EDC). The CF is 0.6 with an 11.7 eV lamp. During calibration with 100 ppm isobutylene, insert 0.6 times 100, or 60 at the prompt for the calibration gas concentration. The unit then reads directly in EDC values.

Conversion to mg/m3

To convert from ppm to mg/m3, use the following formula:

$$\text{Conc. (mg/m}^3\text{)} = \frac{\text{[Conc.(ppmv) x mol. wt. (g/mole)]}}{\text{molar gas volume (L)}}$$

For air at 25°C (77°F), the molar gas volume is 24.4 L/mole and the formula reduces to:

$$\text{Conc.(mg/m}^3\text{)} = \text{Conc.(ppmv) x mol. wt. (g/mole) x 0.041}$$

For example, if the instrument is calibrated with a gas standard in ppmv, such as 100 ppm isobutylene, and the user wants the display to read in mg/m^3 of hexane, whose m.w. is 86 and CF is 4.3, the overall correction factor would be 4.3 x 86 x 0.041 equals 15.2.

Correction Factors for Mixtures

The correction factor for a mixture is calculated from the sum of the mole fractions Xi of each component divided by their respective correction factors CFi:

$$CFmix = 1 / (X_1/CF_1 + X_2/CF_2 + X_3/CF_3 + ... Xi/CFi)$$

Thus, for example, a vapor phase mixture of 5% benzene and 95% n-hexane would have a CFmix of CFmix = 1 / (0.05/0.53 + 0.95/4.3) = 3.2. A reading of 100 would then correspond to 320 ppm of the total mixture, comprised of 16 ppm benzene and 304 ppm hexane.

For a spreadsheet to compute the correction factor and TLV of a mixture see the appendix at the end of the CF table.

TLVs and Alarm Limits for Mixtures

The correction factor for mixtures can be used to set alarm limits for mixtures. To do this one first needs to calculate the exposure limit for the mixture. The Threshold Limit Value (TLV) often defines exposure limits. The TLV for the mixture is calculated in a manner similar to the CF calculation:

$$TLV\ mix = 1 / (X_1/TLV_1 + X_2/TLV_2 + X_3/TLV_3 + ... Xi/TLVi)$$

In the above example, the 8-h TLV for benzene is 0.5 ppm and for n-hexane 50 ppm. Therefore the TLV of the mixture is TLVmix = 1 / (0.05/0.5 + 0.95/50) = 8.4 ppm, corresponding to 8.0 ppm hexane and 0.4 ppm benzene. For an instrument calibrated on isobutylene, the reading corrsponding to the TLV is:

$$Alarm\ Reading = TLVmix / CFmix = 8.4 / 3.2 = 2.6\ ppm$$

A common practice is to set the lower alarm limit to half the TLV, and the higher limit to the TLV. Thus, one would set the alarms to 1.3 and 2.6 ppm, respectively.

CALIBRATION CHARACTERISTICS

A. Flow Configuration. PID response is essentially independent of gas flow rate as long as it is sufficient to satisfy the pump demand. Four main flow configurations are used for calibrating a PID:

1. Pressurized gas cylinder (Fixed-flow regulator): The flow rate of the regulator should match the flow demand of the instrument pump or be slightly higher.
2. Pressurized gas cylinder (Demand-flow regulator): A demand-flow regulator better matches pump speed differences, but results in a slight vacuum during calibration and thus slightly high readings.
3. Collapsible gas bag: The instrument will draw the calibration gas from the bag at its normal flow rate, as long as the bag valve is large enough. The bag should be filled with enough gas to allow at least one minute of flow (~ 0.6 L for a MiniRAE, ~0.3 L for MultiRAE).
4. T (or open tube) method: The T method uses a T-junction with gas flow higher than the pump draw. The gas supply is connected to one end of the T, the instrument inlet is connected to a second end of the T, and excess gas flow escapes through the third, open end of the T. To prevent ambient air mixing, a long tube should be connected to the open end, or a high excess rate should be used. Alternatively, the instrument probe can be inserted into an open tube slightly wider than the probe. Excess gas flows out around the probe.

The first two cylinder methods are the most efficient in terms of gas usage, while the bag and T methods give slightly more accurate results because they match the pump flow better.

B. Pressure. Pressures deviating from atmospheric pressure affect the readings by altering gas concentration and pump characteristics. It is best to calibrate with the instrument and calibration gas at the same pressure as each other and the sample gas. (Note that the cylinder pressure is not relevant because the regulator reduces the pressure to ambient.) If the instrument is calibrated at atmospheric pressure in one of the flow configurations described above, then 1) pressures slightly above ambient are acceptable but high pressures can damage the pump and 2) samples under vacuum may give low readings if air leaks into the sample train.

C. Temperature. Because temperature effects gas density and concentration, the temperature of the calibration gas and instrument should be as close as possible to the ambient temperature where the unit will be used. We recommend that the temperature of the calibration gas be within the instrument's temperature specification (typically 14° to 113° F or -10° to 45° C). Also, during actual measurements, the instrument should be kept at the same or higher temperature than the sample temperature to avoid condensation in the unit.

D. Matrix. The matrix gas of the calibration compound and VOC sample is significant. Some common matrix components, such as methane and water vapor can affect the VOC signal.

PIDs are most commonly used for monitoring VOCs in air, in which case the preferred calibration gas matrix is air. For a MiniRAE, methane, methanol, and water vapor reduce the response by about 20% when their concentration is 15,000 ppm and by about 40% at 30,000 ppm. Despite earlier reports of oxygen effects, RAE PID responses with 10.6 eV lamps are independent of oxygen concentration, and calibration gases in a pure nitrogen matrix can be used. H_2 and CO_2 up to 5 volume % also have no effect.

E. Concentration. Although RAE Systems PIDs have electronically linearized output, it is best to calibrate in a concentration range close to the actual measurement range. For example, 100 ppm standard gas for anticipated vapors of 0 to 250 ppm, and 500 ppm standard for expected concentrations of 250 to 1000 ppm. The correction factors in this table were typically measured at 50 to 100 ppm and apply from the ppb range up to about 1000 ppm. Above 1000 ppm the CF may vary and it is best to calibrate with the gas of interest near the concentration of interest.

F. Filters. Filters affect flow and pressure conditions and therefore all filters to be used during sampling should also be in place during calibration. Using a water trap (hydrophobic filter) greatly reduces the chances of drawing water aerosols or dirt particles into the instrument. Regular filter replacements are recommended because dirty filters can adsorb VOCs and cause slower response time and shifts in calibration.

G. Instrument Design. High-boiling ("heavy") or very reactive compounds can be lost by reaction or adsorption onto materials in the gas sample train, such as filters, pumps and other sensors. Multi-gas meters, including EntryRAE, MultiRAE and AreaRAE have the pump and other sensors upstream of the PID and are prone to these losses. Compounds possibly affected by such losses are shown in green in the table, and may give slow response, or in extreme cases, no response at all. In many cases the multi-gas meters can still give a rough indication of the relative concentration, without giving an accurate, quantitative reading. The ppbRAE and MiniRAE series instruments have inert sample trains and therefore do not exhibit significant loss; nevertheless, response may be slow for the very heavy compounds and additional sampling time up to a minute or more should be allowed to get a stable reading.

TABLE ABBREVIATIONS

CF = Correction Factor (multiply by reading to get corrected value for the compound when calibrated to isobutylene)

NR = No Response

IE = Ionization Energy (values in parentheses are not well established)

C = Confirmed Value indicated by "+" in this column; all others are preliminary or estimated values and are subject to change

ne = Not Established ACGIH 8-hr. TWA

C## = Ceiling value, given where 8-hr.TWA is not available

DISCLAIMER

TN-106 is a general guideline for Correction Factors (CF) for use with PID instruments manufactured by RAE Systems. The CF may vary depending on instrument and operation conditions. For the best accuracy, RAE Systems recommends calibrating the instrument to target gas. Actual readings may vary with age and cleanliness of lamp, relative humidity, and other factors as well. For accurate work, the instrument should be calibrated regularly under the operating conditions used. The factors in this table on the following pages were measured in dry air (40 to 50% RH) at room temperature, typically at 50 to 100 ppm. CF values may vary above about 1000 ppm.

Updates

The values in this table on the following pages are subject to change as more or better data become available. Watch for updates of this table on the Internet at **http://www.raesystems.com**.

IE data are taken from the CRC Handbook of Chemistry and Physics, 73rd Edition, D.R. Lide (Ed.), CRC Press (1993) and NIST Standard Ref. Database 19A, NIST Positive Ion Energetics, Vers. 2.0, Lias, et.al., U.S. Dept. Commerce (1993). Exposure limits (8-h TWA and Ceiling Values) are from the 2005 ACGIH Guide to Occupational Exposure Values, ACGIH, Cincinnati, OH 2005. Equations for exposure limits for mixtures of chemicals were taken from the 1997 TLVs and BEIs handbook published by the ACGIH (1997).

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	0.9	+	1.4	+	9.71	500
Acetone cyanohydrin	2-Hydroxyisobutyronitrile	75-86-5	C_4H_7NO					4	+	11.1	C5
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2.1	+	11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O	4.5	+	2.4	+	1.6	+	9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	NH_3	NR	+	10.9	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5				10.00	ne
Aniline	Aminobenzene	62-53-3	C_6H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O	0.89	+	0.58	+	0.56	+	8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzene		71-43-2	C_6H_6	0.55	+	0.47	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne
Benzyl chloride	α-Chlorotoluene, Chloromethylbenzene	100-44-7	C_7H_7Cl	0.7	+	0.6	+	0.5	+	9.14	1
Benzyl formate	Formic acid benzyl ester	104-57-4	$C_8H_8O_2$	0.9	+	0.73	+	0.66	+		ne
Boron trifluoride		7637-07-2	BF_3	NR		NR		NR		15.5	C1
Bromine		7726-95-6	Br_2	NR	+	1.30	+	0.74	+	10.51	0.1
Bromobenzene		108-86-1	C_6H_5Br			0.6		0.5		8.98	ne
2-Bromoethyl methyl ether		6482-24-2	C_3H_7OBr			0.84	+			~10	ne
Bromoform	Tribromomethane	75-25-2	$CHBr_3$	NR	+	2.7	+	0.5	+	10.48	0.5
Bromopropane,1-	n-Propyl bromide	106-94-5	C_3H_7Br	150	+	1.5	+	0.6	+	10.18	ne
Butadiene	1,3-Butadiene, Vinyl ethylene	106-99-0	C_4H_6	0.8		0.6	+	1.1		9.07	2
Butadiene diepoxide, 1,3-	1,2,3,4-Diepoxybutane	298-18-0	$C_4H_6O_2$	25	+	3.5	+	1.2		~10	ne
Butane		106-97-8	C_4H_{10}			67	+	1.2		10.53	800
Butanol, 1-	Butyl alcohol, n-Butanol	71-36-3	$C_4H_{10}O$	70	+	4.7	+	1.4	+	9.99	20
Butanol, t-	tert-Butanol, t-Butyl alcohol	75-65-0	$C_4H_{10}O$	6.9	+	2.9	+			9.90	100
Butene, 1-	1-Butylene	106-98-9	C_4H_8			0.9				9.58	ne
Butoxyethanol, 2-	Butyl Cellosolve, Ethylene glycol monobutyl ether	111-76-2	$C_6H_{14}O_2$	1.8	+	1.2	+	0.6	+	<10	25
Butoxyethyl Acetate, 2-	2-Butoxyethyl acetate; 2-Butoxy-ethanol acetate; Butyl Cellosolve acetate; Butyl glycol acetate; EGBEA; Ektasolve EB acetate	112-07-2	$C_8H_{16}O_3$			1.27	+				20
Butyl acetate, n-		123-86-4	$C_6H_{12}O_2$			2.6	+			10	150
Butyl acrylate, n-	Butyl 2-propenoate, Acrylic acid butyl ester	141-32-2	$C_7H_{12}O_2$			1.6	+	0.6	+		10
Butylamine, n-		109-73-9	$C_4H_{11}N$	1.1	+	1.1	+	0.7	+	8.71	C5
Butyl cellosolve see 2-Butoxyethanol		111-76-2									
Butyl hydroperoxide, t-		75-91-2	$C_4H_{10}O_2$	2.0	+	1.6	+			<10	1

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Butyl mercaptan	1-Butanethiol	109-79-5	$C_4H_{10}S$	0.55	+	0.52	+			9.14	0.5
Butyraldehyde	Butanal	123-72-8	C_4H_8O			1.87	+			9.82	20
Camelinal HRJ						1.1	+	0.32	+		
Camelinal HRJ/JP-8 50/50						0.89	+	0.41	+		
CamelinalHRJ						1.15	+				
CamelinalHRJ/JP-8						1.07	+				
Carbon disulfide		75-15-0	CS_2	4	+	1.2	+	0.44		10.07	10
Carbon tetrachloride	Tetrachloromethane	56-23-5	CCl_4	NR	+	NR	+	1.7	+	11.47	5
Carbonyl sulfide	Carbon oxysulfide	463-58-1	COS							11.18	
Cellosolve see 2-Ethoxyethanol											
CFC-14 see Tetrafluoromethane											
CFC-113 see 1,1,2-Trichloro-1,2,2-trifluoroethane											
Chlorine		7782-50-5	Cl_2					1.0	+	11.48	0.5
Chlorine dioxide		10049-04-4	ClO_2	NR	+	NR	+	NR	+	10.57	0.1
Chlorobenzene	Monochlorobenzene	108-90-7	C_6H_5Cl	0.44	+	0.55	+	0.39	+	9.06	10
Chlorobenzotrifluoride, 4-	PCBTF, OXSOL 100 p-Chlorobenzotrifluoride	98-56-6	$C_7H_4ClF_3$	0.74	+	0.63	+	0.55	+	<9.6	
Chloro-1,3-butadiene, 2-	Chloroprene	126-99-8	C_4H_5Cl			3					10
Chloro-1,1-difluoroethane, 1-	HCFC-142B, R-142B	75-68-3	$C_2H_3ClF_2$	NR		NR		NR		12.0	ne
Chlorodifluoromethane	HCFC-22, R-22	75-45-6	$CHClF_2$	NR		NR		NR		12.2	1000
Chloroethane	Ethyl chloride	75-00-3	C_2H_5Cl	NR	+	NR	+	1.1	+	10.97	100
Chloroethanol	Ethylene chlrohydrin	107-07-3	C_2H_5ClO							10.52	C1
Chloroethanol, 2-	2-Chloroethanol; 2-Chloroethyl alcohol; Ethylene chlorhydrin	107-07-3	C_2H_5ClO			2.88	+			10.5	5
Chloroethyl ether, 2-	bis (2-chloroethyl) ether	111-44-4	$C_4H_8Cl_2O$	8.6	+	3.0	+				5
Chloroethyl methyl ether, 2-	Methyl 2-chloroethyl ether	627-42-9	C_3H_7ClO			3					ne
Chloroform	Trichloromethane	67-66-3	$CHCl_3$	NR	+	NR	+	3.5	+	11.37	10
Chloro-2-methylpropene, 3-	Methallyl chloride, Isobutenyl chloride	563-47-3	C_4H_7Cl	1.4	+	1.2	+	0.63	+	9.76	ne
Chloropicrin		76-06-2	CCl_3NO_2	NR	+	~400	+	7	+		0.1
Chlorotoluene, o-	o-Chloromethylbenzene	95-49-8	C_7H_7Cl			0.5		0.6		8.83	50
Chlorotoluene, p-	p-Chloromethylbenzene	106-43-4	C_7H_7Cl					0.6		8.69	ne
Chlorotrifluoroethene	CTFE, Chlorotrifluoroethylene Genetron 1113	79-38-9	C_2ClF_3	6.7	+	3.9	+	1.2	+	9.76	5
Chlorotrimethylsilane		75-77-4	C_3H_9ClSi	NR		NR		0.82	+	10.83	ne
Cresol, m-	m-Hydroxytoluene, 3-Methylphenol	108-39-4	C_7H_8O	0.57	+	0.50	+	0.57	+	8.29	5
Cresol, o-	ortho-Cresol; 2-Cresol; o-Cresylic acid; 1-Hydroxy-2-methylbenzene; 2-Hydroxytoluene; 2-Methyl phenol	95-48-7	C_7H_8O			1	+			8.14	5
Cresol, p-	para-Cresol; 4-Cresol; p-Cresylic acid; 1-Hydroxy-4-methylbenzene; 4-Hydroxytoluene; 4-Methyl phenol	106-44-5	C_7H_8O			1.4	+			8.34	5
Crotonaldehyde	trans-2-Butenal	123-73-9 4170-30-3	C_4H_6O	1.5	+	1.1	+	1.0	+	9.73	2
Cumene	Isopropylbenzene	98-82-8	C_9H_{12}	0.58	+	0.54	+	0.4	+	8.73	50
Cyanogen bromide		506-68-3	CNBr	NR		NR		NR		11.84	ne
Cyanogen chloride		506-77-4	CNCl	NR		NR		NR		12.34	C0.3
Cyclohexane		110-82-7	C_6H_{12}	3.3	+	1.4	+	0.64	+	9.86	300
Cyclohexanol	Cyclohexyl alcohol	108-93-0	$C_6H_{12}O$	1.5	+	0.9	+	1.1	+	9.75	50
Cyclohexanone		108-94-1	$C_6H_{10}O$	1.0	+	0.9	+	0.7	+	9.14	25

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Cyclohexene		110-83-8	C_6H_{10}			0.8	+			8.95	300
Cyclohexylamine		108-91-8	$C_6H_{13}N$			1.2				8.62	10
Cyclopentane 85% 2,2-dimethylbutane 15%		287-92-3	C_5H_{10}	NR	+	15	+	1.1		10.33	600
Cyclopropylamine	Aminocyclpropane	765-30-0	C_3H_7N	1.1	+	0.9	+	0.9	+		ne
Decamethylcyclopentasiloxane		541-02-6	$C_{10}H_{30}O_5Si_5$	0.16	+	0.13	+	0.12	+		ne
Decamethyltetrasiloxane		141-62-8	$C_{10}H_{30}O_3Si_4$	0.17	+	0.13	+	0.12	+	<10.2	ne
Decane		124-18-5	$C_{10}H_{22}$	4.0	+	1.4	+	0.35	+	9.65	ne
Diacetone alcohol	4-Methyl-4-hydroxy-2-pentanone	123-42-2	$C_6H_{12}O_2$			0.7					50
Dibromochloromethane	Chlorodibromomethane	124-48-1	$CHBr_2Cl$	NR	+	5.2	+	0.7	+	10.59	ne
Dibromo-3-chloropropane, 1,2-	DBCP	96-12-8	$C_3H_5Br_2Cl$	NR	+	1.7	+	0.43	+		0.001
Dibromoethane, 1,2-	EDB, Ethylene dibromide, Ethylene bromide	106-93-4	$C_2H_4Br_2$	NR	+	1.7	+	0.6	+	10.37	ne
Dichlorobenzene, o-	1,2-Dichlorobenzene	95-50-1	$C_6H_4Cl_2$	0.54	+	0.64	+	0.38	+	9.08	25
Dichlorodifluoromethane	CFC-12	75-71-8	CCl_2F_2			NR	+	NR	+	11.75	1000
Dichlorodimethylsilane		75-78-5	$C_2H_6Cl_2Si$	NR		NR		1.1	+	>10.7	ne
Dichloroethane, 1,2-	EDC, 1,2-DCA, Ethylene dichloride	107-06-2	$C_2H_4Cl_2$			NR	+	0.6	+	11.04	10
Dichloroethene, 1,1-	1,1-DCE, Vinylidene chloride	75-35-4	$C_2H_2Cl_2$			0.82	+	0.8	+	9.79	5
Dichloroethene, c-1,2-	c-1,2-DCE, *cis*-Dichloroethylene	156-59-2	$C_2H_2Cl_2$			0.8				9.66	200
Dichloroethene, t-1,2-	t-1,2-DCE, *trans*-Dichloroethylene	156-60-5	$C_2H_2Cl_2$			0.45	+	0.34	+	9.65	200
Dichloro-1-fluoroethane, 1,1-	R-141B	1717-00-6	$C_2H_3Cl_2F$	NR	+	NR	+	2.0	+		ne
Dichloromethane see Methylene chloride											
Dichloropentafluoropropane	AK-225, mix of ~45% 3,3-dichloro-1,1,1,2,2-pentafluoro-propane (HCFC-225ca) & ~55% 1,3-Dichloro-1,1,2,2,3-penta-fluoropropane (HCFC-225cb)	442-56-0 507-55-1	$C_3HCl_2F_5$	NR	+	NR	+	25	+		ne
Dichloropropane, 1,2-		78-87-5	$C_3H_6Cl_2$					0.7		10.87	75
Dichloro-1-propene, 1,3-		542-75-6	$C_3H_4Cl_2$	1.3	+	0.96	+			<10	1
Dichloro-1-propene, 2,3-		78-88-6	$C_3H_4Cl_2$	1.9	+	1.3	+	0.7	+	<10	ne
Dichloro-1,1,1- trifluoroethane, 2,2-	R-123	306-83-2	$C_2HCl_2F_3$	NR	+	NR	+	10.1	+	11.5	ne
Dichloro-2,4,6- trifluoropyridine, 3,5-	DCTFP	1737-93-5	$C_5Cl_2F_3N$	1.1	+	0.9	+	0.8	+		ne
Dichlorvos**	Vapona; O,O-dimethyl O-dichlorovinyl phosphate	62-73-7	$C_4H_7Cl_2O_4P$			0.9	+			<9.4	0.1
Dicyclopentadiene	DCPD, Cyclopentadiene dimer	77-73-6	$C_{10}H_{12}$	0.57	+	0.48	+	0.43	+	8.8	5
Diesel Fuel**		68334-30-5	m.w. 226			0.9	+				11
Diesel Fuel #2 (Automotive)**		68334-30-5	m.w. 216	1.3		0.7	+	0.4	+		11
Diethylamine		109-89-7	$C_4H_{11}N$			1	+			8.01	5
Diethylaminopropylamine, 3-		104-78-9	$C_7H_{18}N_2$			1.3					ne
Diethylbenzene see Dowtherm J											
Diethyl ether	Diethyl ether; Diethyl oxide; Ethyl oxide; Ether; Solvent ether	60-29-7	$C_4H_{10}O$			1.74	+			9.51	400
Diethylene glycol butyl ether	2-(2-Butoxyethoxy)ethanol, BDG, Butyldiglycol, DB Solvent	112-34-5	$C_8H_{18}O_3$			4.6	+				5
Diethylene glycol monobutyl ether acetate	Butyldiglycol acetate, DB Acetate, Diethylene glycol monobutyl ether acetate	124-17-4	$C_{10}H_{20}O_4$			5.62	+				ne
Diethylmaleate		141-05-9	$C_8H_{12}O_4$			4					ne
Diethyl sulfide see Ethyl sulfide											
Diglyme see Methoxyethyl ether		111-96-6	$C_6H_{14}O_3$								

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Diisobutyl ketone	DIBK, 2,2-dimethyl-4-heptanone	108-83-8	$C_9H_{18}O$	0.71	+	0.61	+	0.35	+	9.04	25
Diisopropylamine		108-18-9	$C_6H_{15}N$	0.84	+	0.74	+	0.5	+	7.73	5
Diisopropylcarbodiimide,N,N'-	DIPC	693-13-0	$C_7H_{14}N_2$			0.42	+				ne
Diisopropylethylamine	'Hünig's base', *N*-Ethyldiisopropylamine, DIPEA, Ethyldiisopropylamine	7087-68-5	$C_8H_{19}N$			0.7	+				ne
Diketene	Ketene dimer	674-82-8	$C_4H_4O_2$	2.6	+	2.0	+	1.4	+	9.6	0.5
Dimethylacetamide, N,N-	DMA	127-19-5	C_4H_9NO	0.87	+	0.8	+	0.8	+	8.81	10
Dimethylamine		124-40-3	C_2H_7N			1.5				8.23	5
Dimethyl carbonate	Carbonic acid dimethyl ester	616-38-6	$C_3H_6O_3$	NR	+	~70	+	1.7	+	~10.5	ne
Dimethyl disulfide	DMDS	624-92-0	$C_2H_6S_2$	0.2	+	0.20	+	0.21	+	7.4	ne
Dimethyl ether see Methyl ether											
Dimethylethylamine	DMEA	598-56-1	$C_4H_{11}N$	1.1	+	1.0	+	0.9	+	7.74	~3
Dimethylformamide, N,N-	DMF	68-12-2	C_3H_7NO	0.7	+	0.7	+	0.8	+	9.13	10
Dimethylhydrazine, 1,1-	UDMH	57-14-7	$C_2H_8N_2$			0.8	+	0.8	+	7.28	0.01
Dimethyl methylphosphonate	DMMP, methyl phosphonic acid dimethyl ester	756-79-6	$C_3H_9O_3P$	NR	+	4.3	+	0.74	+	10.0	ne
Dimethyl sulfate		77-78-1	$C_2H_6O_4S$	~23		~20	+	2.3	+		0.1
Dimethyl sulfide see Methyl sulfide											
Dimethyl sulfoxide	DMSO, Methyl sulfoxide	67-68-5	C_2H_6OS			1.4	+			9.10	ne
Dioxane, 1,4-		123-91-1	$C_4H_8O_2$			1.3				9.19	25
Dioxolane, 1,3-	Ethylene glycol formal	646-06-0	$C_3H_6O_2$	4.0	+	2.3	+	1.6	+	9.9	20
Dowtherm A see Therminol®**											
Dowtherm J (97% Diethylbenzene)**		25340-17-4	$C_{10}H_{14}$			0.5					
DS-108F Wipe Solvent	Ethyl lactate/Isopar H/ Propoxypropanol ~7:2:1	97-64-3 64742-48-9 1569-01-3	m.w. 118	3.3	+	1.6	+	0.7	+		ne
Epichlorohydrin	ECH Chloromethyloxirane, 1-chloro2,3-epoxypropane	106-89-8	C_2H_5ClO	~200	+	8.5	+	1.4	+	10.2	0.5
Ethane		74-84-0	C_2H_6			NR	+	15	+	11.52	ne
Ethanol	Ethyl alcohol	64-17-5	C_2H_6O			9.6	+	3.1	+	10.47	1000
Ethanolamine**	MEA, Monoethanolamine	141-43-5	C_2H_7NO	5.6	+	1.6	+			8.96	3
Ethene	Ethylene	74-85-1	C_2H_4			9	+	4.5	+	10.51	ne
Ethoxyethanol, 2-	Ethyl cellosolve, Ethylene glycol monoethyl ether	110-80-5	$C_4H_{10}O_2$			1.3				9.6	5
Ethyl acetate	Acetic ester; Acetic ether; Ethyl ester of acetic acid; Ethyl ethanoate	141-78-6	$C_4H_8O_2$			3.8	+			10.01	400
Ethyl acetoacetate		141-97-9	$C_6H_{10}O_3$	1.4	+	1.2	+	1.0	+	<10	ne
Ethyl acrylate		140-88-5	$C_5H_8O_2$			2.4	+	1.0	+	<10.3	5
Ethylactate	Acetic ester; Acetic ether; Ethyl ester of acetic acid; Ethyl ethanoate	141-78-6	$C_4H_8O_2$					2.18	+	10.01	400
Ethylamine		75-04-7	C_2H_7N			0.8				8.86	5
Ethylbenzene		100-41-4	C_8H_{10}	0.52	+	0.65	+	0.51	+	8.77	100
Ethyl caprylate	Ethyl octanoate	106-32-1	$C_{10}H_{20}O_2$		+	0.52	+	0.51	+		
Ethylenediamine	1,2-Ethanediamine; 1,2-Diaminoethane	107-15-3	$C_2H_8N_2$	0.9	+	0.8	+	1.0	+	8.6	10
(Ethylenedioxy)diethanethiol, 2,2'-	1,2-Bis(2-mercaptoethoxy)ethane, 3,6-Dioxa-1,8-octane-dithiol	14970-87-7	$C_6H_{14}O_2S_2$			1.3	+				ne
Ethylene glycol**	1,2-Ethanediol	107-21-1	$C_2H_6O_2$			16	+	6	+	10.16	C100
Ethylene glycol, Acrylate**	2-hydroxyethyl Acrylate	818-61-1	$C_5H_8O_3$			8.2				≤10.6	
Ethylene glycol dimethyl ether	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		1.1		0.7		9.2	ne

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Ethylene glycol monobutyl ether acetate	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		1.1		0.7		9.2	ne
Ethylene glycol, monothio		60-24-2	C_2H_6OS			1.5				9.65	
Ethylene oxide	Oxirane, Epoxyethane	75-21-8	C_2H_4O			13	+	3.5	+	10.57	1
Ethyl ether	Diethyl ether	60-29-7	$C_4H_{10}O$			1.1	+			9.51	400
Ethyl 3-ethoxypropionate	EEP	763-69-9	$C_7H_{14}O_3$	1.2	+	0.75	+				ne
Ethyl formate		109-94-4	$C_3H_6O_2$					1.9		10.61	100
Ethyl-1-hexanol, 2-	Isooctyl alcohol	104-76-7	$C_8H_{18}O$			1.9	+				ne
Ethyl hexyl acrylate, 2-	Acrylic acid 2-ethylhexyl ester	103-11-7	$C_{11}H_{20}O_2$			1.1	+	0.5	+		ne
Ethylidenenorbornene	5-Ethylidene bicyclo(2,2,1) hept-2-ene	16219-75-3	C_9H_{12}	0.4	+	0.39	+	0.34	+	≤8.8	ne
Ethyl (S)-(-)-lactate see also DS-108F	Ethyl lactate, Ethyl (S)-(-)-hydroxypropionate	687-47-8 97-64-3	$C_5H_{10}O_3$	13	+	3.2	+	1.6	+	~10	ne
Ethyl mercaptan	Ethanethiol	75-08-1	C_2H_6S	0.60	+	0.56	+			9.29	0.5
Ethyl sulfide	Diethyl sulfide	352-93-2	$C_4H_{10}S$			0.5	+			8.43	ne
Formaldehyde	Formalin	50-00-0	CH_2O	NR	+	NR	+	1.6	+	10.87	C0.3
Formamide		75-12-7	CH_3NO			6.9	+	4		10.16	10
Formic acid		64-18-6	CH_2O_2	NR	+	NR	+	9	+	11.33	5
Furfural	2-Furaldehyde	98-01-1	$C_5H_4O_2$			0.92	+	0.8	+	9.21	2
Furfuryl alcohol		98-00-0	$C_5H_6O_2$			0.80	+			<9.5	10
Gasoline #1		8006-61-9	m.w. 72			0.9	+				300
Gasoline #2, 92 octane		8006-61-9	m.w. 93	1.3	+	1.0	+	0.5	+		300
Glutaraldehyde	1,5-Pentanedial, Glutaric dialdehyde	111-30-8	$C_5H_8O_2$	1.1	+	0.8	+	0.6	+		C0.05
Glycidyl methacrylate	2,3-Epoxypropyl methacrylate	106-91-2	$C_7H_{10}O_3$	2.6	+	1.2	+	0.9	+		0.5
Halothane	2-Bromo-2-chloro-1,1,1-trifluoroethane	151-67-7	$C_2HBrClF_3$					0.6		11.0	50
HCFC-22 see Chlorodifluoromethane											
HCFC-123 see 2,2-Dichloro-1,1,1-trifluoroethane											
HCFC-141B see 1,1-Dichloro-1-fluoroethane											
HCFC-142B see 1-Chloro-1,1-difluoroethane											
HCFC-134A see 1,1,1,2-Tetrafluoroethane											
HCFC-225 see Dichloropentafluoropropane											
Heptane, n-		142-82-5	C_7H_{16}	45	+	2.8	+	0.60	+	9.92	400
Heptanol, 4-	Dipropylcarbinol	589-55-9	$C_7H_{16}O$	1.8	+	1.3	+	0.5	+	9.61	ne
Hexamethyldisilazane, 1,1,1,3,3,3-**	HMDS	999-97-3	$C_6H_{19}NSi_2$			0.2	+	0.2	+	~8.6	ne
Hexamethyldisiloxane	HMDSx	107-46-0	$C_6H_{18}OSi_2$	0.33	+	0.27	+	0.25	+	9.64	ne
Hexane, n-		110-54-3	C_6H_{14}	350	+	4.3	+	0.54	+	10.13	50
Hexanol, 1-	Hexyl alcohol	111-27-3	$C_6H_{14}O$	9	+	2.5	+	0.55	+	9.89	ne
Hexene, 1-		592-41-6	C_6H_{12}			0.8				9.44	30
HFE-7100 see Methyl nonafluorobutyl ether											
Histoclear (Histo-Clear)	Limonene/corn oil reagent		m.w. ~136	0.5	+	0.4	+	0.3	+		ne
Hydrazine**		302-01-2	H_4N_2	>8	+	2.6	+	2.1	+	8.1	0.01
Hydrazoic acid	Hydrogen azide		HN_3							10.7	
Hydrogen	Synthesis gas	1333-74-0	H_2	NR	+	NR	+	NR	+	15.43	ne
Hydrogen cyanide	Hydrocyanic acid	74-90-8	HCN	NR	+	NR	+	NR	+	13.6	C4.7
Hydrogen iodide**	Hydriodic acid	10034-85-2	HI			~0.6				10.39	
Hydrogen peroxide		7722-84-1	H_2O_2	NR	+	NR	+	NR	+	10.54	1
Hydrogen sulfide		7783-06-4	H_2S	NR	+	3.3	+	1.5	+	10.45	10
Hydroxyethyl acrylate, 2-	Ethylene glycol monoacrylate	818-61-1	$C_5H_8O_3$			8.2	+				ne

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Hydroxypropyl methacrylate		27813-02-1 923-26-2	$C_7H_{12}O_3$	9.9	+	2.3	+	1.1	+		ne
Iodine**		7553-56-2	I_2	0.1	+	0.1	+	0.1	+	9.40	C0.1
Iodomethane	Methyl iodide	74-88-4	CH_3I	0.21	+	0.22	+	0.26	+	9.54	2
Isoamyl acetate	Isopentyl acetate	123-92-2	$C_7H_{14}O_2$	10.1		2.1		1.0		<10	100
Isobutane	2-Methylpropane	75-28-5	C_4H_{10}			100	+	1.2	+	10.57	ne
Isobutanol	2-Methyl-1-propanol	78-83-1	$C_4H_{10}O$	19	+	3.8	+	1.5		10.02	50
Isobutene	Isobutylene, Methyl butene	115-11-7	C_4H_8	1.00	+	1.00	+	1.00	+	9.24	ne
Isobutyl acetate	2-methylpropyl ethanoate, β-methylpropyl acetate	110-19-0	$C_6H_{12}O_2$			2.1	+			9.97	150
Isobutyl acrylate	Isobutyl 2-propenoate, Acrylic acid Isobutyl ester	106-63-8	$C_7H_{12}O_2$			1.5	+	0.60	+		ne
Isoflurane	1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether, forane	26675-46-7	$C_3H_2ClF_5O$	NR	+	NR	+	48	+	~11.7	ne
Isooctane	2,2,4-Trimethylpentane	540-84-1	C_8H_{18}			1.2				9.86	ne
Isopar E Solvent	Isoparaffinic hydrocarbons	64741-66-8	m.w. 121	1.7	+	0.8	+				ne
Isopar G Solvent	Photocopier diluent	64742-48-9	m.w. 148			0.8	+				ne
Isopar K Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 156	0.9	+	0.5	+	0.27	+		ne
Isopar L Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 163	0.9	+	0.5	+	0.28	+		ne
Isopar M Solvent	Isoparaffinic hydrocarbons	64742-47-8	m.w. 191			0.7	+	0.4	+		ne
Isopentane	2-Methylbutane	78-78-4	C_5H_{12}			8.2					ne
Isophorone		78-59-1	$C_9H_{14}O$					3		9.07	C5
Isoprene	2-Methyl-1,3-butadiene	78-79-5	C_5H_8	0.69	+	0.63	+	0.60	+	8.85	ne
Isopropanol	Isopropyl alcohol, 2-propanol, IPA	67-63-0	C_3H_8O	500	+	4.6	+	2.7		10.12	200
Isopropyl acetate		108-21-4	$C_5H_{10}O_2$			2.6				9.99	100
Isopropyl ether	Diisopropyl ether	108-20-3	$C_6H_{14}O$			0.8				9.20	250
Jet fuel JP-4	Jet B, Turbo B, F-40 Wide cut type aviation fuel	8008-20-6 + 64741-42-0	m.w. 115			1.0	+	0.4	+		ne
Jet fuel JP-5	Jet 5, F-44, Kerosene type aviation fuel	8008-20-6 + 64747-77-1	m.w. 167			0.6	+	0.5	+		29
Jet fuel JP-8	F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 165			0.94	+	0.3	+		30
Jet fuel A-1	F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 145			0.67					34
Jet Fuel TS	Thermally Stable Jet Fuel, Hydrotreated kerosene fuel	8008-20-6 + 64742-47-8	m.w. 165	0.9	+	0.6	+	0.3	+		30
JP-10						0.7	+	0.5	+		
JP5, Petroleum/camelinal						1.05	+				
JP5/Petroleum						0.98	+				
Limonene, D-	(R)-(+)-Limonene	5989-27-5	$C_{10}H_{16}$			0.33	+			~8.2	ne
Kerosene C10-C16 petro.distillate see Jet Fuels		8008-20-6									
MDI see 4,4'-Methylenebis (phenylisocyanate)											
Maleic anhydride	2,5-Furandione	108-31-6	$C_4H_2O_3$							~10.8	0.1
Mercapto-2-ethanol	β-Mercaptoethanol, 2-Hydroxyethylmercaptan, BME, Thioethylene glycol	60-24-2	C_2H_6OS			1.5	+			9.65	0.2
Mesitylene	1,3,5-Trimethylbenzene	108-67-8	C_9H_{12}	0.36	+	0.35	+	0.3	+	8.41	25
Methallyl chloride see 3-Chloro-2-methylpropene											
Methane	Natural gas	74-82-8	CH_4	NR	+	NR	+	NR	+	12.61	ne
Methanol	Methyl alcohol, carbinol	67-56-1	CH_4O	NR	+	NR	+	2.5	+	10.85	200
Methoxyethanol, 2-	Methyl cellosolve, Ethylene glycol monomethyl ether	109-86-4	$C_3H_8O_2$	4.8	+	2.4	+	1.4	+	10.1	5

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Methoxyethoxyethanol, 2-	2-(2-Methoxyethoxy)ethanol Diethylene glycol monomethyl ether	111-77-3	$C_5H_{12}O_3$	2.3	+	1.2	+	0.9	+	<10	ne
Methoxyethyl ether, 2-	bis(2-Methoxyethyl) ether, Diethylene glycol dimethyl ether, Diglyme	111-96-6	$C_6H_{14}O_3$	0.64	+	0.54	+	0.44	+	<9.8	ne
Methyl acetate		79-20-9	$C_3H_6O_2$	NR	+	6.6	+	1.4	+	10.27	200
Methyl acrylate	Methyl 2-propenoate, Acrylic acid methyl ester	96-33-3	$C_4H_6O_2$			3.7	+	1.2	+	(9.9)	2
Methylamine	Aminomethane	74-89-5	CH_5N			1.2				8.97	5
Methyl amyl ketone	MAK, 2-Heptanone, Methyl pentyl ketone	110-43-0	$C_7H_{14}O$	0.9	+	0.85	+	0.5	+	9.30	50
Methylaniline, N-	MA; (Methylamino) benzene; N-Methyl aniline; Methylphenylamine; N-Phenylmethylamin	100-61-8	C_7H_9N			0.68	+			7.32	2
Methyl bromide	Bromomethane	74-83-9	CH_3Br	110	+	1.7	+	1.3	+	10.54	1
Methyl-2-butanol, 2-	*tert*-Amyl alcohol, *tert*-Pentyl alcohol	75-85-4	$C_5H_{12}O$			1.62	+			10.16	100
Methyl t-butyl ether	MTBE, tert-Butyl methyl ether	1634-04-4	$C_5H_{12}O$			0.9	+			9.24	40
Methyl cellosolve see 2-Methoxyethanol											
Methyl chloride	Chloromethane	74-87-3	CH_3Cl	NR	+	NR	+	0.74	+	11.22	50
Methylcyclohexane		107-87-2	C_7H_{14}	1.6	+	0.97	+	0.53	+	9.64	400
Methylene bis (phenyl-isocyanate), 4,4'-**	MDI, Mondur M		$C_{15}H_{10}N_2O_2$	Very slow ppb level response							0.005
Methylene chloride	Dichloromethane	75-09-2	CH_2Cl_2	NR	+	NR	+	0.89	+	11.32	25
Methyl ether	Dimethyl ether	115-10-6	C_2H_6O	4.8	+	3.1	+	2.5	+	10.03	ne
Methyl ethyl ketone	MEK, 2-Butanone	78-93-3	C_4H_8O	0.86	+	1.0	+	1.1	+	9.51	200
Methylhydrazine	Monomethylhydrazine, Hydrazomethane	60-34-4	$C_2H_6N_2$	1.4	+	1.2	+	1.3	+	7.7	0.01
Methyl isoamyl ketone	MIAK, 5-Methyl-2-hexanone	110-12-3	$C_7H_{14}O$	0.8	+	0.76	+	0.5	+	9.28	50
Methyl isobutyl ketone	MIBK, 4-Methyl-2-pentanone	108-10-1	$C_6H_{12}O$	0.9	+	0.8	+	0.6	+	9.30	50
Methyl isocyanate		624-83-9	C_2H_3NO	NR	+	4.6	+	1.5		10.67	0.02
Methyl isothiocyanate		551-61-6	C_2H_3NS	0.5	+	0.45	+	0.4	+	9.25	ne
Methyl mercaptan	Methanethiol	74-93-1	CH_4S	0.65		0.54		0.66		9.44	0.5
Methyl methacrylate		80-62-6	$C_5H_8O_2$	2.7	+	1.5	+	1.2	+	9.7	100
Methyl nonafluorobutyl ether	HFE-7100DL	163702-08-7, 163702-07-6	$C_5H_3F_9O$			NR	+	~35	+		ne
Methyl-1,5-pentanediamine, 2- (coats lamp)**	Dytek-A amine, 2-Methyl pentamethylenediamine	15520-10-2	$C_6H_{16}N_2$			~0.6	+			<9.0	ne
Methyl propyl ketone	MPK, 2-Pentanone	107-87-9	$C_5H_{12}O$			0.93	+	0.79	+	9.38	200
Methyl-2-pyrrolidinone, N-	NMP, N-Methylpyrrolidone, 1-Methyl-2-pyrrolidinone, 1-Methyl-2-pyrrolidone	872-50-4	C_5H_9NO	1.0	+	0.8	+	0.9	+	9.17	ne
Methyl salicylate**	Methyl 2-hydroxybenzoate	119-36-8	$C_8H_8O_3$	1.3	+	0.9	+	0.9	+	~9	ne
Methylstyrene, α-	2-Propenylbenzene	98-83-9	C_9H_{10}			0.5				8.18	50
Methyl sulfide	DMS, Dimethyl sulfide	75-18-3	C_2H_6S	0.49	+	0.44	+	0.46	+	8.69	ne
Methyl vinyl ketone	MVK, 3-Buten-2-one	78-94-4	C_4H_6O			0.93	+			9.65	ne
Methyltetrahydrofuran	2-MeTHF, Tetrahydro-2-methylfuran, Tetrahydrosilvan	96-47-9	$C_5H_{10}O$			2.44	+			9.22	ne
Mineral spirits	Stoddard Solvent, Varsol 1, White Spirits	8020-83-5 8052-41-3 68551-17-7	m.w. 144	1.0		0.69	+	0.38	+		100
Mineral Spirits	Viscor 120B Calibration Fluid, b.p. 156-207°C	8052-41-3	m.w. 142	1.0	+	0.7	+	0.3	+		100

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Monoethanolamine see Ethanolamine											
Mustard	HD, Bis (2-chloroethyl) sulfide	505-60-2 39472-40-7 68157-62-0	$C_4H_8Cl_2S$			0.6					0.0005
Naphtha see VM & P Naphtha											
Naphthalene	Mothballs	91-20-3	$C_{10}H_8$	0.45	+	0.42	+	0.40	+	8.13	10
Nickel carbonyl (in CO)	Nickel tetracarbonyl	13463-39-3	C_4NiO_4			0.18				<8.8	0.001
Nicotine	3-(1-Methyl-2-pyrrolidyl)pyridine	54-11-5	$C_{10}H_{14}N_2$			1.98	+				ne
Nitric oxide		10102-43-9	NO	~6		5.2	+	2.8	+	9.26	25
Nitrobenzene		98-95-3	$C_6H_5NO_2$	2.6	+	1.9	+	1.6	+	9.81	1
Nitroethane		79-24-3	$C_2H_5NO_2$					3		10.88	100
Nitrogen dioxide		10102-44-0	NO_2	23	+	16	+	6	+	9.75	3
Nitrogen trifluoride		7783-54-2	NF_3	NR		NR		NR		13.0	10
Nitromethane		75-52-5	CH_3NO_2					4		11.02	20
Nitropropane, 2-		79-46-9	$C_3H_7NO_2$					2.6		10.71	10
Nonane		111-84-2	C_9H_{20}			1.4				9.72	200
Norpar 12	n-Paraffins, mostly C_{10}-C_{13}	64771-72-8	m.w. 161	3.2	+	1.1	+	0.28	+		ne
Norpar 13	n-Paraffins, mostly C_{13}-C_{14}	64771-72-8	m.w. 189	2.7	+	1.0	+	0.3	+		ne
Octamethylcyclotetrasiloxane		556-67-2	$C_8H_{24}O_4Si_4$	0.21	+	0.17	+	0.14	+		ne
Octamethyltrisiloxane		107-51-7	$C_8H_{24}O_2Si_3$	0.23	+	0.18	+	0.17	+	<10.0	ne
Octane, n-		111-65-9	C_8H_{18}	13	+	1.8	+			9.82	300
Octene, 1-		111-66-0	C_8H_{16}	0.9	+	0.75	+	0.4	+	9.43	75
Pentachloropropane	1,1,1,3,3-pentachloropropane	23153-23-3	$C_3H_3Cl_5$					1.25	+		0.1
Pentane		109-66-0	C_5H_{12}	80	+	8.4	+	0.7	+	10.35	600
Peracetic acid**	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$	NR	+	NR	+	2.3	+		ne
Peracetic/Acetic acid mix**	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$			50	+	2.5	+		ne
Perchloroethene	PCE, Perchloroethylene, Tetrachloroethylene	127-18-4	C_2Cl_4	0.69	+	0.57	+	0.31	+	9.32	25
Propylene glycol methyl ether, 1-Methoxy-2-propanol	PGME	107-98-2	$C_6H_{12}O_3$	2.4	+	1.5	+	1.1	+		100
Propylene glycol methyl ether acetate, 1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate	PGMEA	108-65-6	$C_6H_{12}O_3$	1.65	+	1.0	+	0.8	+		ne
Phenol	Hydroxybenzene	108-95-2	C_6H_6O	1.0	+	1.0	+	0.9	+	8.51	5
Phosgene	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	8.5	+	11.2	0.1
Phosgene in Nitrogen	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	6.8	+	11.2	0.1
Phosphine (coats lamp)		7803-51-2	PH_3	28		3.9	+	1.1	+	9.87	0.3
Photocopier Toner	Isoparaffin mix					0.5	+	0.3	+		ne
Picoline, 3-	3-Methylpyridine	108-99-6	C_6H_7N			0.9				9.04	ne
Pinene, α-		2437-95-8	$C_{10}H_{16}$			0.31	+	0.47		8.07	ne
Pinene, β-		18172-67-3	$C_{10}H_{16}$	0.38	+	0.37	+	0.37	+	~8	100
Piperylene, isomer mix	1,3-Pentadiene	504-60-9	C_5H_8	0.76	+	0.69	+	0.64	+	8.6	100
Propane		74-98-6	C_3H_8			NR	+	1.8	+	10.95	2500
Propanol, n-	Propyl alcohol	71-23-8	C_3H_8O			5.5		1.7		10.22	200
Propene	Propylene	115-07-1	C_3H_6	1.5	+	1.4	+	1.6	+	9.73	ne
Propionaldehyde	Propanal	123-38-6	C_3H_6O			1.9				9.95	ne
Propyl acetate, n-		109-60-4	$C_5H_{10}O_2$			3.5				10.04	200
Propyl acetate	Propylacetate; n-Propyl ester of acetic acid	109-60-4	$C_5H_{10}O_2$			2.27	+			10.04	200

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Propylamine, n-	1-Propylamine, 1-Aminopropane	107-10-8	C_3H_9N	1.1	+	1.1	+	0.9	+	8.78	ne
Propylene carbonate**		108-32-7	$C_4H_6O_3$			62	+	1	+	10.5	ne
Propylene glycol	1,2-Propanediol	57-55-6	$C_3H_8O_2$	18		4.2	+	1.6	+	<10.2	ne
Propylene glycol propyl ether	1-Propoxy-2-propanol	1569-01-3	$C_6H_{14}O_2$	1.3	+	1.0	+	1.6	+		ne
Propylene oxide	Methyloxirane	75-56-9 16088-62-3 15448-47-2	C_3H_6O	~240		6.6	+	2.9	+	10.22	20
Propyleneimine	2-Methylaziridine	75-55-8	C_3H_7N	1.5	+	1.3	+	1.0	+	9.0	2
Propyl mercaptan, 2-	2-Propanethiol, Isopropyl mercaptan	75-33-2	C_3H_8S	0.64	+	0.66	+			9.15	ne
Pyridine		110-86-1	C_5H_5N	0.78	+	0.7	+	0.7	+	9.25	5
Pyrrolidine (coats lamp)	Azacyclohexane	123-75-1	C_4H_9N	2.1	+	1.3	+	1.6	+	~8.0	ne
RR7300 (PGME/PGMEA)	70:30 PGME:PGMEA (1-Methoxy-2-propanol: 1-Methoxy-2-acetoxypropane)	107-98-2	$C_4H_{10}O_2$/ $C_6H_{12}O_3$			1.4	+	1.0	+		ne
Sarin	GB, Isopropyl methylphosphonofluoridate	107-44-8 50642-23-4	$C_4H_{10}FO_2P$			~3					
Shell SPK						1.26	+				
Shell SPK						1.29	+	0.4	+		
Shell SPK 50/50						1.02	+	0.41	+		
Shell SPK/JP-8						1.11	+				
Stoddard Solvent see Mineral Spirits		8020-83-5									
Styrene		100-42-5	C_8H_8	0.45	+	0.43	+	0.4	+	8.43	20
Sulfur dioxide		7446-09-5	SO_2	NR		NR	+	NR	+	12.32	2
Sulfur hexafluoride		2551-62-4	SF_6	NR		NR		NR		15.3	1000
Sulfuryl fluoride	Vikane	2699-79-8	SO_2F_2	NR		NR		NR		13.0	5
Tabun**	Ethyl N, N-dimethylphosphoramidocyanidate	77-81-6	$C_5H_{11}N_2O_2P$			0.8					15ppt
Tallow HRJ						1.09	+				
Tallow HRJ						0.95	+	0.36	+		
Tallow HRJ/JP-8						1.14	+				
Tallow HRJ/JP-8 50/50						0.9	+	0.39	+		
Tetrachloroethane, 1,1,1,2-		630-20-6	$C_2H_2Cl_4$					1.3		~11.1	ne
Tetrachloroethane, 1,1,2,2-		79-34-5	$C_2H_2Cl_4$	NR	+	NR	+	0.60	+	~11.1	1
Tetrachlorosilane		10023-04-7	$SiCl_4$	NR		NR		15	+	11.79	ne
Tetraethyllead	TEL	78-00-2	$C_8H_{20}Pb$	0.4		0.3		0.2		~11.1	0.008
Tetraethyl orthosilicate	Ethyl silicate, TEOS	78-10-4	$C_8H_{20}O_4Si$			0.7	+	0.2	+	~9.8	10
Tetrafluoroethane, 1,1,1,2-	HFC-134A	811-97-2	$C_2H_2F_4$			NR		NR			ne
Tetrafluoroethene	TFE, Tetrafluoroethylene, Perfluoroethylene	116-14-3	C_2F_4			~15				10.12	ne
Tetrafluoromethane	CFC-14, Carbon tetrafluoride	75-73-0	CF_4			NR	+	NR	+	>15.3	ne
Tetrahydrofuran	THF	109-99-9	C_4H_8O	1.9	+	1.7	+	1.0	+	9.41	200
Tetramethyl orthosilicate	Methyl silicate, TMOS	681-84-5	$C_4H_{12}O_4Si$	10	+	1.9	+			~10	1
Therminol® D-12**	Hydrotreated heavy naphtha	64742-48-9	m.w. 160	0.8	+	0.51	+	0.33	+		ne
Therminol® VP-1**	Dowtherm A, 3:1 Diphenyl oxide: Biphenyl	101-84-8 92-52-4	$C_{12}H_{10}O$ $C_{12}H_{10}$			0.4	+				1
Toluene	Methylbenzene	108-88-3	C_7H_8	0.54	+	0.45	+	0.51	+	8.82	50
Tolylene-2,4-diisocyanate	TDI, 4-Methyl-1,3-phenylene-2,4-diisocyanate	584-84-9	$C_9H_6N_2O_2$	1.4	+	1.4	+	2.0	+		0.002
Trichlorobenzene, 1,2,4-	1,2,4-TCB	120-82-1	$C_6H_3Cl_3$	0.7	+	0.9	+			9.04	C5
Trichloroethane, 1,1,1-	1,1,1-TCA, Methyl chloroform	71-55-6	$C_2H_3Cl_3$			NR	+	1	+	11	350

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Trichloroethane, 1,1,2-	1,1,2-TCA	79-00-5	$C_2H_3Cl_3$	NR	+	NR	+	0.9	+	11.0	10
Trichloroethene	TCE, Trichoroethylene	79-01-6	C_2HCl_3	0.62	+	0.54	+	0.43	+	9.47	50
Trichloromethylsilane	Methyltrichlorosilane	75-79-6	CH_3Cl_3Si	NR		NR		1.8	+	11.36	ne
Trichlorotrifluoroethane, 1,1,2-	CFC-113	76-13-1	$C_2Cl_3F_3$			NR		NR		11.99	1000
Triethylamine	TEA	121-44-8	$C_6H_{15}N$	0.95	+	0.9	+	0.65	+	7.3	1
Triethyl borate	TEB; Boric acid triethyl ester, Boron ethoxide	150-46-9	$C_6H_{15}O_3B$			2.2	+	1.1	+	~10	ne
Triethyl phosphate	Ethyl phosphate	78-40-0	$C_6H_{15}O_4P$	~50	+	3.1	+	0.60	+	9.79	ne
Trifluoroethane, 1,1,2-		430-66-0	$C_2H_3F_3$					34		12.9	ne
Trimethylamine		75-50-3	C_3H_9N			0.9				7.82	5
Trimethylbenzene, 1,3,5- see Mesitylene		108-67-8									25
Trimethyl borate	TMB; Boric acid trimethyl ester, Boron methoxide	121-43-7	$C_3H_9O_3B$			5.1	+	1.2	+	10.1	ne
Trimethyl phosphate	Methyl phosphate	512-56-1	$C_3H_9O_4P$			8.0	+	1.3	+	9.99	ne
Trimethyl phosphite	Methyl phosphite	121-45-9	$C_3H_9O_3P$			1.1	+		+	8.5	2
Turpentine	Pinenes (85%) + other diisoprenes	8006-64-2	$C_{10}H_{16}$	0.37	+	0.4	+	0.29	+	~8	20
Undecane		1120-21-4	$C_{11}H_{24}$			2				9.56	ne
Varsol see Mineral Spirits											
Vinyl actetate		108-05-4	$C_4H_6O_2$	1.5	+	1.2	+	1.0	+	9.19	10
Vinyl bromide	Bromoethylene	593-60-2	C_2H_3Br			0.4				9.80	5
Vinyl chloride	Chloroethylene, VCM	75-01-4	C_2H_3Cl			2.0	+	0.6	+	9.99	5
Vinyl-1-cyclohexene, 4-	Butadiene dimer, 4-Ethenylcyclohexene	100-40-3	C_8H_{12}	0.6	+	0.56	+			9.83	0.1
Vinylidene chloride see 1,1-Dicholorethene											
Vinyl-2-pyrrolidinone, 1-	NVP, N-vinylpyrrolidone, 1-ethenyl-2-pyrrolidinone	88-12-0	C_6H_9NO	1.0	+	0.8	+	0.9	+		ne
Viscor 120B see Mineral Spirits—Viscor 120B Calibration Fluid											
V. M. & P. Naphtha	Ligroin; Solvent naphtha; Varnish maker's & painter's naphtha	64742-89-8	m.w. 111 (C_8-C_9)	1.7	+	0.97	+				300
Xylene, m-	1,3-Dimethylbenzene	108-38-3	C_8H_{10}	0.50	+	0.44	+	0.40	+	8.56	100
Xylene, o-	1,2-Dimethylbenzene	95-47-6	C_8H_{10}	0.56	+	0.45	+	0.43		8.56	100
Xylene, p-	1,4-Dimethylbenzene	106-42-3	C_8H_{10}	0.48	+	0.39	+	0.38	+	8.44	100

* The term "ionization energy" is more scientifically correct and replaces the old term "ionization potential." High-boiling ("heavy") compounds may not vaporize enough to give a response even when their ionization energies are below the lamp photon energy. Some inorganic compounds like H_2O_2 and NO_2 give weak response even when their ionization energies are well below the lamp photon energy.

** Compounds indicated in green can be detected using a MiniRAE 3000, UltraRAE 3000 or ppbRAE 3000 with slow response, but may be lost by adsorption on a MultiRAE, EntryRAE and AreaRAE. Response on multi-gas meters can give an indication of relative concentrations, but may not be quantitative and for some chemicals no response is observed.

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HUMIDITY FILTERING II TUBE FOR PID MEASUREMENTS IN HUMID ENVIRONMENTS

INTRODUCTION

RAE Systems' photoionization detectors (PIDs) are designed to make real-time monitoring of VOCs practical throughout a wide humidity range. However, PID response can be reduced by high humidity (Figure 1). In addition, a false positive reading can result if the sensor is dirty or if water condenses in the sample line and the sensor (Figure 2). For false positives, the preferred solution is good sensor cleanliness and instrument maintenance, as described in Technical Note 163. The humidity filtering tubes described in this Technical Note address humidity issues and allow more accurate measurements for many chemicals.

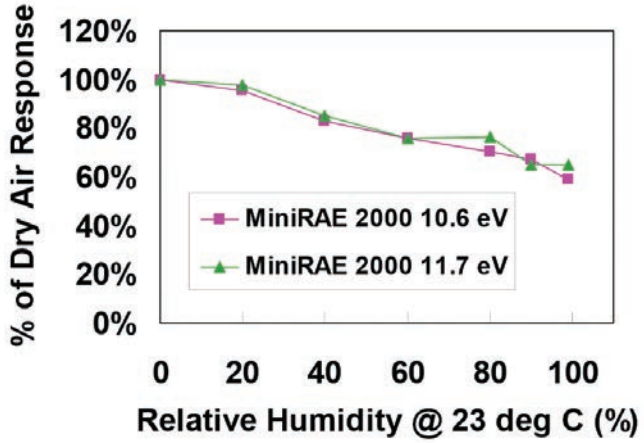


Figure 1. Response to test gas with clean sensor

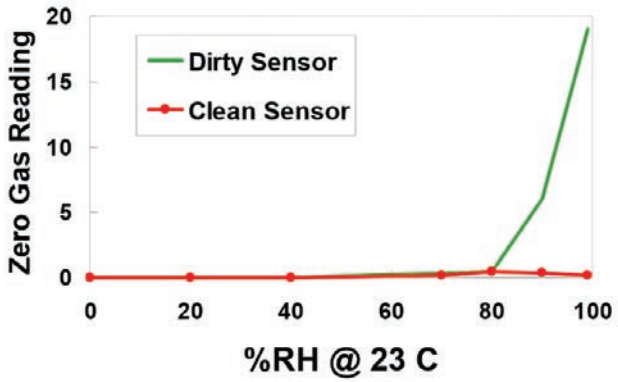


Figure 2. Response to zero gas vs humidity on "dirty" vs "clean" sensor

High humidity situations that can cause problems include:

- Soil vapor extraction systems.
- Combustion stack gases.
- Moving from a cool location to a hot humid area, such as calibrating in an air-conditioned lab and moving outdoors.

Humidity Filtering II Tubes

A Humidity Filtering II tube (p/n 025-2002-010) attached to the inlet of a PID can reduce humidity for the times listed in Table 1. The tube can be used while measuring organic vapors, with some precautions (see below). Do not confuse this tube with the Humidity Filtering I tube (p/n 025-2001-010), which cannot be used while measuring organic vapors.

Table 1. Run times for the Humidity Filtering II tubes.

T (°C)	T (°F)	RH (%)	10% RH Break-through time (min @ 500 mL/min)	20% RH Break-through time (min @ 500 mL/min)
45	113	100	12	14
		75	17	18
		50	35	>40
		25	>40	>40
40	104	100	18	20
		75	25	30
		50	40	>40
30	86	100	22	26
		75	28	32
		50	40	>40
20	68	100	23	~30
		75	34	>40
		50	40	>40

At extreme sample conditions such as 45°C (113°F), 100% RH (relative humidity) and 500mL/min flow rate, the humidity filtering tube can maintain <20% RH downstream for at least 14 min, as shown in Table 1. At this low RH, the effects shown in Figures 1 and 2 are almost completely removed. Under more typical conditions, the protection time can be expected to be much longer (see Table 1). A worst-case humidity break-through curve is shown in Figure 3.

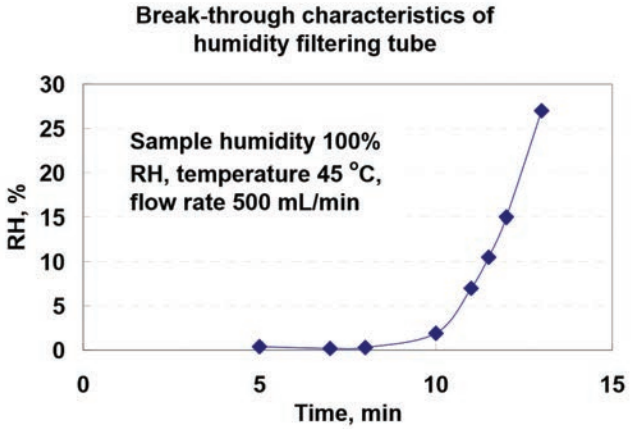


Figure 3. Worst-case break-through curve. (Note: 45° C is higher than some instrument ratings.)

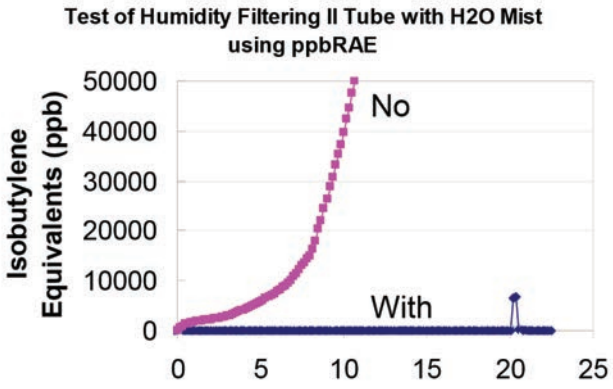


Figure 4. Test of Humidity Filtering II tube in the presence of water mist using a ppbRAE 3000.

The tubes are sealed and broken open immediately before use. They are intended for single use, but might be used for a few samples if within a short time or if the tube ends are capped. There is no color change in the tube, but a spent tube can be identified by a glassy gel formation on the solid absorbent.

Caution: The tube contents may liquify after very long sampling or if a tube is left open in ambient air for several days. We recommend disposing of tubes soon after use to avoid leakage or having liquid sucked into the instrument.

Effect of Mist

The tubes can be used to measure VOCs in the presence of water mist. As shown in Figure 4, when mist is drawn into a PID with no tube, a false positive reading occurs similar to that in Figure 2. The Humidity Filtering II tube (diamonds on Fig. 4) prevents this and keeps the readings very close to ambient response for at least 20 minutes. The bump check at the end of the test with the tube with about 7 ppm (7000 ppb) shows that the tube still responds to VOCs even when it is almost completely saturated with water.

Precautions

Use the tube immediately after opening to avoid loss of absorption capacity.

- Use with caution when making PID measurements with the tube in place, as some compounds may be lost or exhibit delayed response (see Table 2). Contact RAE Systems if the compound to be measured is not listed in Table 2 or the data sheet shipped with the tube.
- Use particular caution at low temperatures and low concentrations because adsorption losses can be relatively more severe. Extended sampling times may be required.
- If unexpectedly low readings are obtained, remove the tube and measure again to check for absorption losses. A rapid rise in a few seconds indicates VOC presence, while a slow rise suggests a false humidity response.
- Do not confuse this tube with the Humidity Filtering I tube (p/n 025-2001-010), which cannot be used while measuring organic vapors.
- Be sure that all connections are tight, or the sample gas will not be properly dried and may be diluted.
- The tube forms a gel and then liquid after excessive moisture has been drawn through. Remove the tube before such a gel fills the tube, because the liquid may be sucked into the PID, possibly causing damage.
- It is still desirable to maintain a clean sensor to prevent drifting readings during measurements in high humidity.
- The contents of the tube are non-toxic and can be disposed of in a landfill. However, the tube may absorb some toxic compounds during use and become contaminated.

Table 2. Effect of Humidity Filtering Tube on VOC Response.

Compound	Concentration (ppm)	T (°C)	t_{90} (sec)	HCF#
Isobutylene	100	22	3	1.0
Isobutylene	10	0	5	1.17
Cyclohexane	10	22	3	1.0
Octane	100	22	3	1.0
Undecane	100	22	60	1.1
Benzene	5	22	3	1.0
Toluene	10	22	3	1.0
Xylenes	100	22	10	1.05
Styrene	50	22	10	1.0
Gasoline	100	22	15	1.05
Gasoline	10	22	15	1.0
Gasoline	10	0	28	1.6
Jet Fuel JP-5	10	22	65	1.0
Diesel Fuel	100	22	110	1.3
Vinyl Chloride	10	22	3	1.0
Tricholoroethylene	10	22	3	1.0
Tricholoroethylene	10	0	5	1.2
Perchloroethylene	10	22	4	1.0
Glutaraldehyde	10	22	NR* (480)	NR* (1.05)
Ethanol	1000	22	3	1.0

Table 2. Effect of Humidity Filtering Tube on VOC Response.

Compound	Concentration (ppm)	T (°C)	t_{90} (sec)	HCF#
Ethanol	100	22	40	1.0
Isopropanol	10	22	90	1.15
Acetone	1000	22	3	1.0
Acetone	100	22	20	1.0
Acetone	10	22	80	1.0
Acetone	10	0	115	1.17
PGMEA (propylene glycol methyl ether acetate)	10	22	240	1.1
Phenol	20	22	150	1.0
Methyl methacrylate	10	22	150	1.05
Dimethyl sulfide	10	22	3	1.0
Ethyl mercaptan	10	22	4	1.05
Butyl mercaptan	10	22	5	1.05
Hydrogen sulfide	7	22	3	1.0
Ethylamine	high	22	NR*	NR*
Ammonia	50	22	NR*	NR*

#HCF = Humidity Correction Factor. Multiply by reading to get true concentration to correct for some loss. If calibrating with isobutylene, must also multiply by the Correction Factor in Technical Note TN-106 to get true concentration.

* Not recommended because of severe losses.

Effect on VOC Response

Note: The data in Table 2 were generated in dry air at about 22°C (72°C). Tests showed that 50% RH does not affect the response time to isobutylene, benzene, PGMEA, dimethyl sulfide, phenol, acetone or ethanol, but causes total loss of ammonia. 80% RH does not affect the response time of isobutylene, benzene, or H_2S. The response time for polar compounds is not significantly different between a fresh tube and a partially used tube up to 20% humidity break-through.

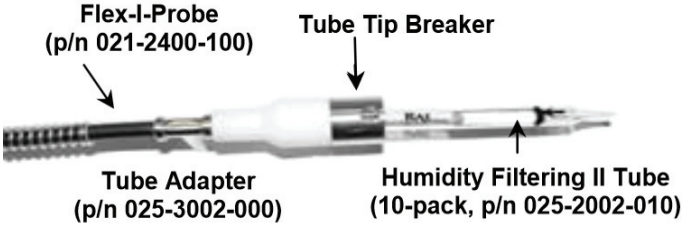
Other compounds: Volatile ethers, esters, haloalkanes, and olefins should not be affected except for possible slower response. Glycols, aldehydes and alcoholamines are expected to have slower and/or lower response. Acids and bases maybe lost on the tube. Compounds that hydrolyze easily, such as acetic anhydride, isocyanates or hexamethydisilazane may be lost.

The tubes can be used to measure a variety of volatile organic compounds (VOCs). The tubes have no effect on the response of nonpolar compounds such as isobutylene, hexane, benzene, and vinyl chloride, but may affect the response time and efficiency of other compounds (see Table 2). Response time is faster at higher concentrations and higher temperature; therefore, at low levels or low temperatures extra measurement time may be required.

CONNECTIONS

MiniRAE 3000, ppbRAE 3000, UltraRAE 3000, and MiniRAE Lite

For the MiniRAE 3000, ppbRAE 3000, UltraRAE 3000, and MiniRAE Lite, the tube is best connected to a Flex-I-Probe (p/n 021-2400-100, as shown above). It is easy to replace the old sample probe with the Flex-I-Probe. All ppbRAE 3000 and MiniRAE 3000 instruments come with this probe as a standard accessory.



Multi-gas Monitors with PID Sensor

To use the humidity filtering tube with RAE Systems' pumped multi-gas monitors with a PID sensor, such as MultiRAE Plus and AreaRAE, a 1"-long Teflon tube (RAE Systems p/n 411-0005-000) can be press fitted into the water-trap filter to connect with the tube adapter, as shown earlier. The end inserted into the tube adapter is also cut at an angle for ease of insertion into the O-ring as described earlier for the UltraRAE 3000.

Procedures

1. Insert the tip of the Flex-I-Probe or other probe into the smaller end of the tube adapter.
2. Break the two ends of a humidity filtering tube using the smaller side hole of the tube adapter.
3. Immediately insert one end (an arrow on the tube indicates the direction) of the open humidity filtering tube into the bigger end of the adapter.
4. Measure the sample gas.
5. Discard the used humidity filtering tube after the maximum time has elapsed as shown in Table 1, or when the tube becomes saturated as shown by a glassy gel formation.

If moving from a cool to a hot, humid environment:

4a. Run the instruments for at least 15 minutes with the humidity filtering in place to warm up the sample line and the instrument sensor. This is useful in order to prevent liquid condensation, even if the sensor is clean and shows no humidity effect.

Sensor Cleaning

Sensor: Dip the entire sensor in to clean anhydrous methanol for at least three minutes (do not disassemble). Using an ultrasonic cleaner is highly recommended.

Lamp crystal: Use a cotton swab to scrub the crystal surface with anhydrous methanol.

Inlet probe: Flow anhydrous methanol through it. Use clean air to dry out all parts.

See Technical Note TN-163 for more details on PID maintenance for avoiding humidity effects.

Attachment C

System (100%) Design Drawings

(Following receipt of USEPA approval of the Remedial Action Work Plan, a complete set of design drawings stamped and certified by a licensed New Jersey professional engineer will be provided.)

Attachment D

Sampling Schedule

Field Sampling Schedule
OU3 ISTR
PVGCS Site, Washington, NJ

Process	Wellfield Vapor				Vapor Treatment					Condensate Treatment			
Sample Location	Group Main Header Pipe[1] A, B, and C (SP100A, SP200B, SP300C)		Vapor Monitoring Ports[2] (VMP-1, 2, 3, 4, and 5)		Vapor Carbon Influent (SP701)		Vapor Carbon Midfluent (SP702)	Vapor Carbon Effluent (SP703)		LGAC Influent (SP801)	LGAC Midfluent (SP802)	Effluent Liquid (SP803)	
Sample Analysis Method	PID	EPA TO-15	PID	Vacuum	EPA TO-15	PID	PID	EPA TO-15	PID	EPA 8260C	EPA 8260C	EPA 8260C/624 EPA 8260 SIM (1,4-dioxane)	TBD per permit, if needed
Sampling Media	Tedlar bag	Summa Canister	Tedlar bag	Magnehelic Gauge	Summa Canister	Tedlar bag	Tedlar bag	Summa Canister	Tedlar bag	40ml VOA vials	40ml VOA vials	40ml VOA vials	Various containers
Sampling Frequency	Weekly	Every other week	Every other week	Every other week	Every other week	Weekly	Weekly	Monthly	Weekly	Monthly	Monthly	Monthly, or as needed per permit	TBD per permit, if needed (assume monthly)

Notes:
1 - PID measurements from each header pipe to be collected using a vacuum pump equipped with a desiccator/vacuum box and Tedlar® bag. A condenser shall be used if moisture and sample temperatures are greater than ambient conditions.
2 - Vacuum and PID measurements to be collected from all vapor sampling port depth intervals at each location.

APPENDIX G

HEALTH AND SAFETY PLANS

Prepared for:
Pechiney Plastic Packaging, Inc.

Date:
November 2019

Project Number:
1690014983

HEALTH AND SAFETY PLAN FOR *IN-SITU* THERMAL REMEDIATION

OPERABLE UNIT 3 REMEDIAL ACTION, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE WARREN COUNTY, NEW JERSEY

TABLE 1A: EMERGENCY RESPONSE TELEPHONE ROSTER

	Office	Cell
CLIENT CONTACT		
Luis Hidalgo, Rio Tinto Project Manager		435-932-3955
Brad Gibson, Rio Tinto Site Manager		801-557-8236
RAMBOLL PERSONNEL		
Principal In Charge / Project Director: Bruce Kennington	312-288-3834	312-953-9965
HSEQ MS Coordinator: Alyssa Larson	303-382-5463	847-732-8656
Project Engineer: Scott Tarmann	262-901-0093	262-853-9964
Project Manager: Stan Popelar	312-288-3858	815-793-6442
Designated Site Safety Officer: Adrian Ezeagu	609-243-9849	517-214-5732
Designated Site Safety Officer: Nita Shinn	813-397-4730	904-947-0789
Designated Site Supervisor: Michael Eddings	913-553-5929	785-250-3648
Designated Site Supervisor: Doug Burge	314-590-2963	314-378-8065
Health & Safety Coordinator: Jeff Parsons		315-391-0638
Global Director, Health and Safety: Jim Fox	315-956-6813	
TRS Group, Inc. – PRIMARY ISTR Contractor		
Senior Project Manager: Christopher Thomas	847-376-3691	360-560-4845
Site Superintendent: Kevin Riffe		
HSE Representative: TBD		
ALBÉA FACILITY/SECURITY		
EHS Leader: Felix Miranda		908-619-2159
Engineering Manager: Russell Gladd	908-835-5231	908-674-1479
GWTT – Existing Systems OMM Contractor		
Project Manager: Pat Biskey	973-983-0901	973-224-4120
HSE Representative: Tiffany Brown		201-317-2063
Site Safety Officers: Mark Turner Teague Alessi		 973-487-6326 973-879-2460
Treatment System Operators: Mark Turner	NA	973-487-6326

EMERGENCY RESPONSE AGENCIES		
Hospital: St. Luke's Warren Hospital	911	
Emergency Fire	911	
Emergency Police	911	
Warren County Health Department	908-475-7960	
Ambulance Service: Washington Emergency Squad	908-689-0909	
Washington Township Emergency Management: Frank Campbell		609-685-1545

OTHER EMERGENCY ASSISTANCE		
CHEMTREC	800-424-9300	
National Response Center (oil and chemical spills)	800-424-8802	
Poison Control Center	800-222-1222	
Federal Emergency Management Agency	202-646-2500	
State Agency: NJ Department of Environmental Protection Hotline	877-927-6337	

OFF-SITE AGENCIES – NON-EMERGENCY PHONE NUMBERS		
Police: Washington Township Police Department	908-689-1630	
Hospital: St. Luke's Warren Hospital	908-859-6700	
Medical Clinic: Medical Care Associates	908-574-5731	
Fire: Washington Fire Department	908-689-3836	
Ambulance Service: Washington Emergency Squad	908-689-0909	
Federal Agency: US Environmental Protection Agency: Region 2	212-637-4232	
State Agency: New Jersey Department of Environmental Protection	866-337-5669	
Washington Township Emergency Management: Frank Campbell	856-589-0523	
General	856-589-6650	

	Emergency	**Non-Emergency**
UTILITIES – EMERGENCY & NON-EMERGENCY PHONE NUMBERS		
Electric: New Jersey Power and Light	888-544-4877	800-662-3115
National Gas: Elizabethtown Gas	800-492-4009	800-242-5830
Vince Holmes, Elizabethtown Gas Representative	908-413-6856	908-413-6856
Water: New Jersey American Water	800-987-5325	800-652-6987
Sewer: Washington Borough Sewer Department	908-835-2000	908-689-0623
Internet/Telephone/Cable: Verizon - Tony Rogers, Local Manager		973-902-3625
Comcast		908-689-3355

TABLE 1B: EMERGENCY SERVICES INSTRUCTIONS

For Emergency Medical Incidents, Emergency Fire Response, or Hazardous Materials Incidents

Emergency Telephone Numbers:

- Hospital: 911
- Police: 911
- Fire Department: 911

1. **Remember to speak SLOWLY and CLEARLY. Do NOT hang up first: let the dispatcher conclude the call.**

2. Provide the following information:

   A Location: **191 Rte 31 North, Washington, NJ 07882**

   B. Your name and phone number

3. Describe nature of Incident:

   A. Emergency Medical Incident:
   - How many victims
   - Type of incident - physical injury, etc.
   - Assessment of victims' condition if known (whether victim is conscious/unconscious, breathing/not breathing, pulse/no pulse, nature of injuries, first aid measures used, etc.)
   - Where incident occurred

   B. Fire:
   - Location of Fire

   C. Hazardous Materials Incident:
   - This is a hazardous materials incident requiring dispatch of HAZMAT unit
   - Type of incident (fire, explosion, spill, etc.)
   - Type of material (specific chemicals or general description)
   - Whether there is also a Medical Emergency

4. Give your location at the Site

Note: Security, Site Supervisor or designee must meet the emergency personnel at the staging area to brief them on the situation.

ROUTE DESCRIPTION AND MAP TO HOSPITAL FROM ALBÉA PROPERTY

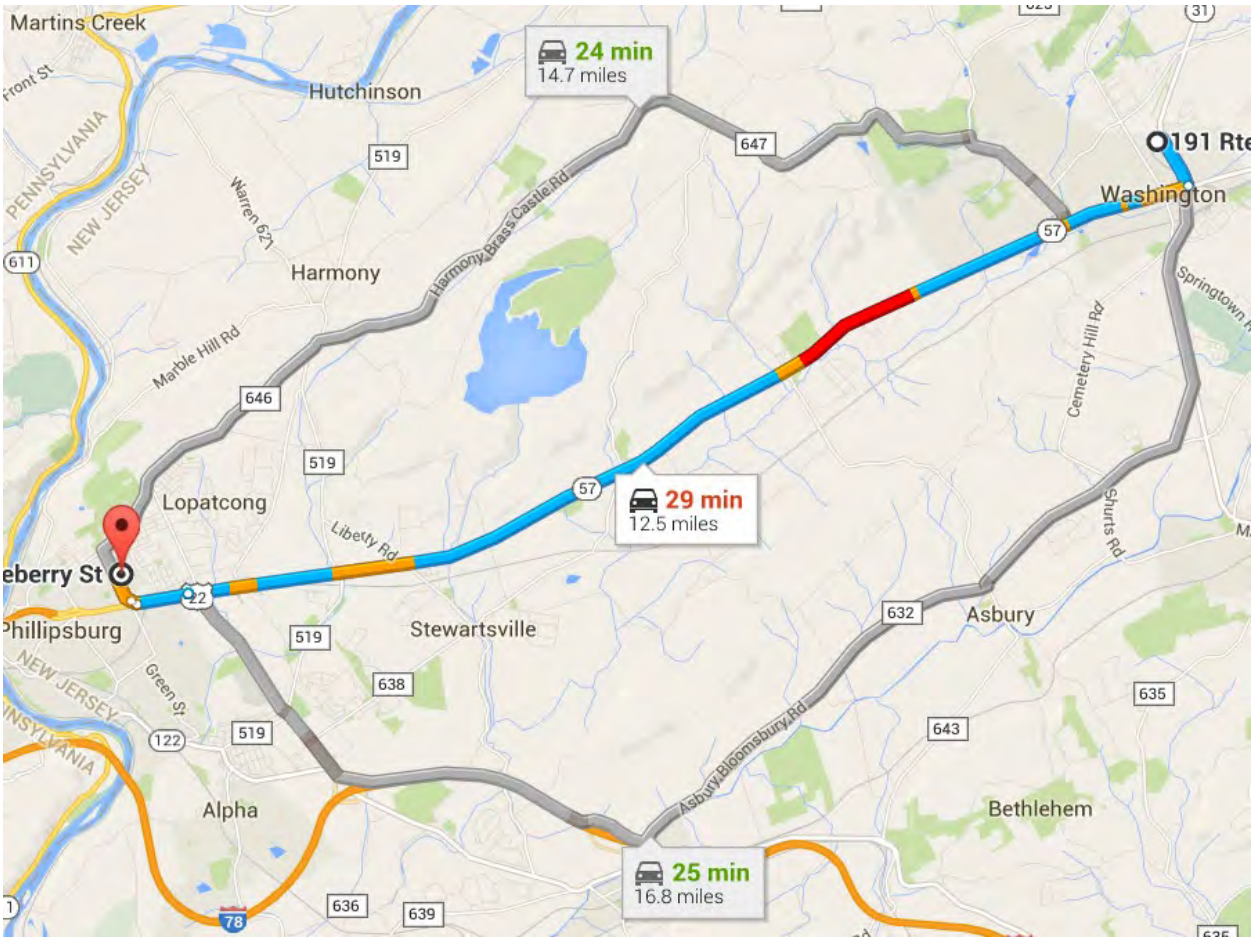
Hospital Information:

Hospital Name: St. Luke's Warren Hospital
Hospital Address: 185 Roseberry St., Phillipsburg, NJ 08865
Hospital Phone Number: 908-859-6700

Directions to Area Hospital:

- Head **south** on Rte 31 toward Myrtle
- Turn right onto NJ-57W/E Washington Ave
- Continue onto US-22W
- Slight right toward Roseberry St
- Slight right onto Roseberry St
- St. Luke's will be on the right

End: 185 Roseberry St, Phillipsburg, NJ (Destination will be on the right)



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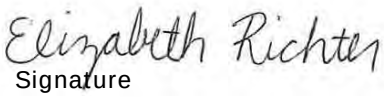
ACRONYMS AND ABBREVIATIONS

AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
APR	Air Purifying Respirator
bgs	Below ground surface
C	Ceiling Limit
CPR	Cardiopulmonary resuscitation
CGI	Combustible gas indicator
CHSSD	Corporate Health, Safety and Security Director
COCs	Chemicals of Concern
dBA	Decibels on the “A” weighted scale
EMR	Experience Modification Rate
Ramboll	Ramboll US Corporation
ERP	Emergency Response Plan
FID	Flame Ionization Detector
GFCI	Ground fault circuit interrupter
GWETS	Groundwater Extraction Treatment System
H	High
HA	Hazard Assessment
HASP	Health & Safety Plan
HSIR	Health & Safety Incident Report
HSC	Health & Safety Coordinator
HSSC	Health & Safety Site Coordinator
HVAC	heating, ventilation, and air conditioning
IDLH	Immediately Dangerous to Life & Health
IR	Infrared Spectrophotometer
JHA	Job Hazard Analysis
LOTO	Lockout/Tagout
L	Low
M	Moderate
SDS	Safety Data Sheet
µg/L	Micrograms per liter
mg/m3	Milligrams per cubic meter
NA	Not Anticipated
NE	Not Established
NIOSH	National Institute for Occupational Safety & Health
NJDEP	New Jersey Department of Environmental Protection
OSHA	Occupational Safety & Health Administration
PC	Program Coordinator

PCE	Tetrachloroethene
PCBs	Polychlorinated biphenyls
PELs	Permissible Exposure Limits
PID	Photoionization detector
PM	Project Manager
POETs	Point-of-entry treatment units
PPE	Personal protective equipment
PPM	Parts per million
PPPI	Pechiney Plastic Packaging, Inc.
PRP	Potentially Responsible Party PSA Potential Source Area
SC	Site Coordinator
SPI	Standard Practice Instruction
SSC	Subsurface Clearance
SSDS	Sub-Slab Depressurization System
STEL	Short Term Exposure Limits
SVOCs	Semi volatile organic compounds
T&C	Terms and Conditions
TCE	Trichloroethene
TLV	Threshold Limit Value
TWA	Time Weighted Average
UV	Ultraviolet
UST	Underground Storage Tank
VMS	Vapor Mitigation System
°C	Degrees Celsius
°F	Degrees Fahrenheit

HEALTH & SAFETY PLAN REVIEW AND APPROVAL

By signing below, it is acknowledged that this Health and Safety Plan (HASP) identifies the activities that are anticipated to be performed in the field. In addition, this HASP identifies the personal protective and monitoring equipment that may be necessary to be on site and be available for use. It is also understood that the provisions of this HASP will be updated if there is a change of a task and/or the addition of tasks and will be approved by the individuals listed below or their designee.

Bruce Kennington Project Director	 Signature	November 15, 2019 Date
Beth Richter Health & Safety Coordinator	 Signature	November 15, 2019 Date
Nita Shinn Designated Site Safety Office	 Signature	November 15, 2019 Date
Cynthia Bonczkiewicz Designated HASP Preparer	 Signature	November 15, 2019 Date

This form MUST be signed and dated prior to starting the on-site work. In addition, a copy of this form should be returned to the office Health and Safety Coordinator prior to leaving for the field. After completion of the project, the original signed HASP must be retained in the project file

1. INTRODUCTION

This Health and Safety Plan (HASP) was prepared to inform all Ramboll US Corporation (Ramboll) personnel of known or reasonably anticipated potential hazards and safety concerns during the OU3 In-situ Thermal Remediation (ISTR) activities at this site. All personnel participating in field activities must be trained in the general and specific hazards unique to the job they are performing and, if applicable, meet recommended medical examination and/or training requirements. All Ramboll employees shall follow the guidelines, rules, and procedures contained in this HASP. Ramboll personnel shall contact the Project Manager (PM) if unexpected conditions are encountered at the site, including but not limited to new processes; changes in operation, products, or services; addition to or changes in the chemicals of concern; and/or unsafe conditions that were not previously addressed in this HASP.

For purposes of this HASP, subcontractors refer to those retained directly or indirectly by Ramboll, and contractors refer to all other entities working on site. Each subcontractor shall be expected to review and understand the hazards, risks, and control methods (including emergency procedures) as outlined in this HASP and sign off on the HASP. This can be accomplished either during the project planning stage or during the first safety briefing on site. However, subcontractors will be required to prepare their own HASP to address site safety and work hazards associated with their proposed site activities prior to mobilization to the site. In addition, each subcontractor will be required to provide Ramboll with their site-specific HASP and communicate the types of hazards and control methods associated with their activities to Ramboll during the first safety briefing on site and as conditions change. Each contractor or subcontractor must assume direct responsibility for its own employees' health and safety. The major subcontractor for the Operable Unit 3 (OU3) ISTR work, TRS Group, Inc., has provided their own project HASP.

Copies of the HASPs will be kept on site for review and reference during all OU3 site activities. Upon completion of the project, the finalized and signed copy of the HASP will be placed in the project file.

When retaining and working with subcontractors, the following minimum requirements shall be met:

- A properly executed Contractor/Subcontractor Terms and Conditions (T&C) agreement with Ramboll will be in place prior to commencing work on-site.
- Insurance policies with limits acceptable to Ramboll have been obtained by the subcontractor, and the subcontractor has supplied applicable Insurance Certificates that are properly executed (i.e., with Ramboll's named as additionally insured under such policies, including Professional and Pollution Liability, if applicable, and with Ramboll's CLIENT named as an insured party under the same policies).
- The roles and responsibilities of the subcontractor have been established, including the naming of the Health and Safety point of contact, which should be clearly indicated in the applicable subcontractor HASP.
- Illness and injury logs for the subcontractor have been provided indicating a favorable total incident rate. The total incident rate for the previous calendar year is calculated by multiplying the total number of cases by 200,000 and dividing by the total hours worked by all employees of the subcontractor. The total incident rate should be equal to or less than the industry average (e.g., for remediation services listed under the North American Industry Classification System [NAICS] 5629 the total incident rate must be equal to or below 3.8).

- The subcontractor has a favorable Experience Modification Rate (EMR) (i.e., a rate equal to or less than 1.0) or has provided an explanation of why they do not qualify for an EMR from their insurance company.

1.1 Site Description

The entire Pohatcong Valley Groundwater Contamination Superfund Site (PVGCS Site) encompasses an area of about 16.5 square miles (10,600 acres) that extends about 10 miles along the length of the Pohatcong Valley. The PVGCS Site is divided into three operable units. OU3 is defined by the USEPA as the source area for TCE within the aquifer, which is identified as the area of the existing Albéa facility. The Albéa facility (formerly called American National Can Company [ANCC]). The Albéa property is bisected by the boundary between Washington Borough (to the south) and Washington Township (to the north).

The Albéa property is relatively flat, with an elevation of approximately 545 feet above mean sea level (amsl). The Albéa property is a 19.62-acre parcel identified as Washington Borough Block 37, Lots 1 and 2 (totaling 17.8 acres), and Washington Township Block 30, Lot 17 (1.82 acres). The Albéa property is developed with an approximately 300,000-square foot building. The interior of the building is comprised of production areas, warehouse space, maintenance areas, mechanical rooms, raw materials storage areas, waste management storage areas, and office space.

1.1.1 Vapor Intrusion (VI)

The Sub-Slab Depressurization Systems (SSDS) consists of a series of 5 sub-slab vapor extraction wells that are located as close as possible to the eastern wall of the facility and 5 sub-slab vapor extraction wells located in the western portion of the Production Area. Each of the SSDS wells has individual conveyance piping systems and use separate radon mitigation-type blowers which operate independently of one another. Following the installation of the 500 cubic feet per minute (CFM) Soil Vapor Extraction (SVE) blower system, the operation of the SSDS along the western portion of the Production Area was discontinued. As an added measure of protection that was built into the SSDS wells ("100 CFM SVE System") along the western wall have been configured to operate only when the long-term SVE system is shut down for short-term maintenance or repairs. The SSDS wells along the eastern wall of the facility continue to operate independently and on a continuous basis to prevent migration of sub-slab vapors through the floor at this location of the Production Area.

1.1.2 Groundwater Extraction and Treatment System (GWETS)

The Groundwater Extraction and Treatment System (GWETS) is designed to remove volatile organic compounds (VOCs), primarily TCE, from the groundwater. The extraction and treatment system primarily consist of 1) extraction wells, 2) submersible pumps, 3) and a filtration and air stripper system that is designed to be fully automated, does not require a full-time treatment plant operator to be on-site, and is anticipated to require minimal routine maintenance. System operations will be continuously recorded via a programmable logic controller (PLC) in the system main control panel with system operations data being stored in an on-site data storage device that can be monitored via a remote telemetry system. System operations data can be downloaded to any remote monitoring device for recordkeeping purposes and conducting operational performance evaluations. Effluent from the treatment system will be discharged or injected back into the shallow bedrock aquifer. In accordance with N.J.A.C. 7-14A-7.5(b) 3(iv), New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Groundwater "Permit-By-Rule" (DGW-PBR) permit equivalency, authorization has been granted to allow the treated groundwater effluent to be discharged to the aquifer.

1.1.3 Groundwater Monitoring

In accordance with the current Monitored Natural Attenuation (MNA) Plan, the MNA sampling to date has been performed quarterly on a well network that includes OU1 and OU2 monitoring wells.

1.2 Site History

OU1 – TCE in Groundwater

Groundwater contamination was first detected in public supply wells in the Pohatcong Valley (the Vannatta St. and Dale Ave. municipal wells) in 1978 and 1979. Subsequent sampling of groundwater in the area led to the identification of regional contamination of the bedrock aquifer. The primary contaminants of concern were identified by the USEPA as TCE and PCE. The USEPA and the NJDEP connected certain properties with private wells to public water supplies and installed treatment units for public water supply wells. Point-of-entry treatment units (POETs) were also supplied for properties that could not be connected to public water supplies.

Below is a summary of the regulatory history at the site:

- From 1985 to 1999, the USEPA and the NJDEP completed limited preliminary investigations to assess both the extent and magnitude of the impact and to evaluate possible source areas or potentially responsible parties (PRPs). Based on non-intrusive investigations, the USEPA identified and ranked potential source areas (PSAs) for further evaluation.
- In April 1999, a Remedial Investigation (RI) Workplan was developed for the site. Implementation of Phase I of the RI began in June 1999 and continued until August 2001. A draft report on the results of the Phase I investigation was completed in October 2001. Implementation of Phase II activities were conducted between September 2001 and October 2002 and included soil, sediment, overburden groundwater and bedrock groundwater sampling. The Draft RI Report, based on the results of both Phase I and II activities, was completed in June 2003. The final RI Report and Feasibility Study (RI/FS) were completed in June 2005.
- A Proposed Remedial Action Plan (PRAP) was prepared and presented to the public in July 2005. The PRAP presented proposed remedies for groundwater and soil for the OU1 portion of the site, which was defined at that time as the contaminated areas in the upgradient portion of the Valley and included soil and groundwater contamination.
- As provided in the USEPA Record of Decision (ROD) (USEPA 2006), the major components of the selected remedy for the TCE portion of OU1 include extraction and treatment of the most contaminated part of TCE-impacted groundwater using a series of extraction wells near the approximate location of the 500 µg/L isoconcentration isopleth; MNA for the portions of the aquifer within OU1 that are downgradient of the approximate location of the 500 µg/L TCE isoconcentration isopleth; establishment of institutional controls, such as the implementation of a Classification Exemption Area, to further restrict the use of groundwater within the OU1 area until the aquifer is restored; and the provision of alternative water supplies to private well users impacted by TCE over applicable standards.
- Pechiney Plastics Packaging Inc. (PPPI) and the USEPA entered into negotiations concerning implementation of the ROD shortly after the ROD was issued. In those negotiations, PPPI indicated a willingness to undertake the implementation of the remedy under a Consent Decree. On September 28, 2007, the USEPA issued a Unilateral Administrative Order (UAO) to PPPI to implement the Remedial Design and Remedial Action for OU1. In response, PPPI requested a conference call with USEPA, which occurred on October 24, 2007. During that conference call, PPPI reiterated its intent to implement the remedy in the ROD. PPPI subsequently provided a notice of the intent to comply with

the UAO in a letter to the USEPA dated November 1, 2007 and a notice to the USEPA of the Supervising Contractor and Project Coordinator on November 13, 2007.

Quarterly MNA sampling was initiated in August 2013 to address one of the major components of the USEPA-selected remedy for TCE in groundwater in OU1 (USEPA 2006). This included long-term monitoring of natural attenuation for target compound list VOCs and SVOCs and target analyte list metals in the downgradient portions of the OU1 (TCE) plume to determine whether these contaminants are meetings the appropriate NJ GWQS or Maximum Contaminant Levels (MCLs), whichever is lower.

Construction of the GWETS was completed in March 2016 and full-scale operations began on Friday, March 25, 2016, including system operation monitoring activities and the collection of air and water samples from the treatment system in accordance with the 2016 *GWETS OM&M Plan* and the associated permits for operation of the GWETS as issued by the NJDEP. Additional design details are presented in the *GWETS Construction Completion Report* to be submitted September 2016.

Vapor Intrusion Time Critical Remedial Action

In March 2013, USEPA collected sub-slab soil gas and indoor air samples from the Albéa facility. The results received on May 7, 2013 indicated that concentrations of TCE in the soil gas were above the NJDEP Non-Residential Soil Gas Screening Levels and the indoor air concentrations were above the NJDEP Non-Residential Indoor Air Screening Levels and Rapid Action Levels. In response, Albéa and Pechiney Plastic Packaging, Inc. (PPPI) have taken multiple measures, including sealing off the source area (i.e., former molding department), increasing fresh air circulation throughout the facility, and sealing floor cracks and drains among others, as detailed in the July 3, 2013 Immediate and Near-Term Response Actions Vapor Intrusion (VI) Mitigation Plan, Albéa Facility, 191 Route 31 North, Washington, NJ by Environmental Resources Management, Inc. (ERM).

A summary of the subsequent vapor intrusion activities is presented below:

- On July 5, 2013, Ramboll initiated an interim remedial action consisting of a temporary 100 CFM SVE system with three soil vapor extraction points (SVE-1, SVE-2 and SVE-4) located in the former molding area, where the highest concentrations of TCE were detected in the soil gas. Since that time, nine (SVE-3 and SVE-5 through SVE-12) additional SVE wells in the Former Molding Area and four SVE wells (SVE-13P through SVE-16P) in the Production Area were installed.
- Two Sub-Slab Depressurization Systems (SSDS) have been installed at the site as a component of the long-term Vapor Mitigation System (VMS). The SSDS serves as an added element of protection to mitigate the potential migration of sub-slab vapor flow through the Production Area floor during SVE operation and in the event of an SVE system shutdown due to system upset or for short-term maintenance or repairs.

Additional details on the SVE system and SSDS are presented in the *Final Design Report for the Soil Vapor Extraction and Mitigation System* submitted October 2015.

OU2 – TCE in Groundwater

Operable Unit 2 (OU2) is defined by the USEPA as the portion of the site downgradient from OU1 where TCE is present in groundwater. As requested by USEPA, Ramboll will implement a monitoring program for the OU2 to update the data collected during the previous sampling event conducted by the USEPA in fall 2013. The groundwater monitoring program includes the sampling of monitoring wells and private potable wells (PPWs) located within the Threatened and Impacted (T&I) Area of OU2. Additional details are presented in the *Final Groundwater Sampling Plan – October 2015*.

OU3- TCE Beneath Albéa Building

The highest concentrations and most frequent detections of TCE were beneath the southwestern corner of the Albéa building. In accordance with the USEPA Record of Decision, the OU3 remedy entails implementation of thermal treatment, along with long-term operation of the sub-slab SVE system noted above and long-term groundwater and air monitoring.

1.3 Scope and Applicability

Ramboll has been retained on behalf of PPPI and its parent company, Rio Tinto, to conduct and/or manage activities at the site.

Ramboll views the implementation of a site-specific HASP as a critical management tool necessary to the safety, health, and well-being of site personnel and the community. Site operations will be performed in such a manner as to minimize the possibility of serious injury or accidents to site personnel, fire, explosion, or any unplanned or sudden release of contaminants into the environment that could adversely affect local receptors. This HASP is intended to be in compliance with all applicable state, federal, and local regulations and is consistent with Ramboll's commitment to the health and safety of its personnel, subcontractors on the site, and the surrounding community.

This HASP identifies potential hazards associated with the OU3 field activities being conducted at the site, establishes the minimum procedural and equipment requirements to protect on-site personnel from potential hazards, and requires that on-site activities are conducted in a manner consistent with both accepted professional practice and applicable regulations. It also describes measures to minimize accidents and injuries that may occur during normal daily activities or during adverse conditions.

The HASP is based upon the currently available information regarding the site and proposed ISTR activities. Operating conditions could potentially change as the work progresses, requiring some modification of the HASP. Any permanent modifications to the HASP, including changes necessary to correct any potential health and safety issues at the site will be made only with permission by those individuals listed in Section 1 of this HASP. Approved changes will be added to the HASP as Addenda.

Applicability of this HASP extends to all Ramboll personnel and subcontractors at the site. However, Ramboll's subcontractors are ultimately responsible for the health and safety of their personnel and representatives and are required to furnish their own HASP. All personnel and visitors entering on-site active fieldwork areas are responsible for reading and acknowledging agreement to comply with the HASP.

1.4 OU3 ISTR Work Activities

The principal features of the OU3 ISTR field activities planned for the site include the following work activities or tasks:

- Task 0 - Site Awareness
- Task 1 – Transportation
- Task 2 – Site Maintenance, Security and Hazard Communication
- Task 3 –Site Inspections
- Task 4 – SVE OM&M (existing sub-slab system)
- Task 5 – Subsurface and Overhead Clearance
- Task 6 – Oversight of Subsurface Drilling

- Task 7 – Investigative-Derived Waste (IDW) Management
- Task 8 – Oversight of Construction/Installation of Vapor and Liquid Treatment Systems
- Task 9 – Oversight of Installation of Heater Wells/VEWs and Associated Instrumentation, Wiring and Electrical Supply
- Task 10 - Oversight of ISTR Commissioning, Startup and Operation
- Task 11 – Process System Sampling and Water Transfer during ISTR Operation, including Hot Soil Sampling.

Each of these Tasks are further described as follows.

Task 0 – Site Awareness

The site encompasses several operable units and a variety of tasks are performed by Facility, Ramboll, and Contractor personnel. At times, these activities are conducted concurrently, which could create logistical difficulties. All Ramboll staff should familiarize themselves with the Sitewide HASP and the Site-Specific ERP before beginning their involvement in the OU3 ISTR activities.

Task 1 – Transportation (off site and on site)

This Task includes driving to and from the site on a daily basis. The commute is approximately 30 minutes each way from the hotel to the site (or offsite work locations) and will include travel on highways and paved side roads. Vehicles are required to enter the Albéa facility at the southern entrance off Route 31, as the northern entrance is a designated for trucks (e.g. tractor trailers, FedEx, etc.).

Ramboll personnel will not text or talk on their cell phones while driving on site or in the community surrounding the Albéa facility. If the phone needs to be used, then the car should be stopped in a safe location and placed in “PARK” before using the phone for calls, texts, GPS, the internet, etc. Ramboll personnel will obey all traffic laws including the posted speed limits.

When driving on site, personnel will follow traffic signs and be cautious of Albéa Facility personnel and delivery trucks.

Task 2 – Site Maintenance, Security and Hazard Communication

Ramboll personnel will coordinate with the Albéa Facility personnel, as necessary, to monitor the site for trespassers, natural disasters (fire, flood, etc.), accidents, etc., and avoid interference with ongoing site operations. Ramboll will discuss the scope of work to be performed in or around the Albéa plant with the Albéa Facility Engineer and Albéa Plant Manager or Health and Safety Director. Communication of the project work areas and potential hazards to the Albéa plant workers will be coordinated by the Facility Engineer in cooperation with Ramboll. Controls will be put in place as appropriate to caution Albéa facility personnel regarding the areas off-limits to them, including areas of exhaust/vapor lines and blower/electrical equipment to be installed for the remedial action.

General site maintenance and security activities include the following.

- Lock doors on the soil vapor extraction system container
- Inspect well heads and bollards for damage
- Ensure doors are clear of hoses and piping and exterior doors are locked
- Perform snow removal

Task 3 – Site Inspections

Site inspections will be performed by Ramboll personnel to evaluate site conditions (e.g., erosion controls, security controls, standing water, etc.). Site inspections will be conducted daily during on-site work. Site inspections include traversing uneven surfaces, vegetated areas, heavy equipment traffic zones, areas where high voltage electrical services will be installed and operating, as well as working during times of low light conditions.

Additionally, because project work will take place in both summer and winter months, field personnel may be susceptible to hazards associated with heat and cold stress. Project working hours will also include non-daylight times and field personnel should be aware of hazards associated with decreased visibility from low light levels.

Task 4 – SVE OM&M (existing sub-slab system)

Routine OM&M tasks will typically be performed by the OM&M contractor but may periodically be performed by Ramboll personnel.

SVE OM&M Tasks are detailed in the *Operation, Maintenance, and Monitoring Plan-Vapor Intrusion Response Activities* in October 2015. These tasks involve the following:

1. Entry into the Albéa facility work area to conduct inspections and measurements of SVE/SSDS monitoring points;
2. Entry into the SVE system trailer to inspect system components and equipment and monitor operational parameters; and
3. System and equipment maintenance will be performed by qualified maintenance contractors.

Task 5 - Subsurface and Overhead Clearance

Prior to conducting invasive subsurface activities, the Ramboll Site Supervisor will confirm the contractor has requested a public utility locate via the local one-call service, as well as a private utility locator, to evaluate the site for the presence of public and private utilities. In addition, the Ramboll Site Supervisor will complete the subsurface clearance checklists provided in this HASP (Table 8 and Appendix C) prior to the start of work. If overhead or subsurface utilities are found to be located within the critical zone (a 5-foot or 1.5-meter area surrounding intrusive locations/areas in every direction) of a given ground disturbance location, the field team will determine if they can move the location of the subsurface work to outside the critical zone. If moving the location of the subsurface work is not possible, the Ramboll Site Supervisor will contact the PM and Corporate Health, Safety and Security Director (CHSSD) for further instructions. Subsurface and Overhead clearance will be performed in accordance with Ramboll Standard Practice Instruction (SPI) 27 Subsurface and Overhead Clearance.

Task 6 - Oversight of Subsurface Drilling

Oversight of contractor during the performance of the subsurface drilling may include observations/documentation of:

A) Coring and/or saw-cutting of concrete floor
B) Soil coring and sampling by Sonic drilling methods for heater borings with co-located vapor extraction wells (VEWs);
C) Steel casing installation including welding of casing/liner sections
D) Soil coring for shallow VEWs and temperature probes
E) Grouting of heater boreholes at completion of ISTR.

Subsurface Drilling Notes:

1. Subsurface clearance (Task 5) is required prior to any subsurface drilling. When drilling, jackhammering and/or concrete saw-cutting, Ramboll will monitor noise levels with a noise dosimeter, as needed. Personnel will don hearing protection when continuous noise levels exceed 85 A-weighted decibels (dBA) or impulse noise levels exceed 140 dBA. Double hearing protection may also be required depending on the measured noise levels and will be determined on a case-by-case basis during some activities, such as drilling or jackhammering. Personnel may also opt to wear dual hearing protection at any time for personal comfort reasons.
2. Outdoor exhausting of the drill rig exhaust will be required during drilling as noted below. Indoor air monitoring will be required during drilling activities, while welding, and when the floor is opened for heater well and fan installation.
3. Due to multiple drill rigs operating concurrently, any re-location of rigs and/or equipment will require coordination with the Ramboll on-site safety officer.
4. A welding screen must be used to protect on-lookers from UV light and welding blankets must be used to protect flammable materials that cannot be removed from the area during welding. Additionally, exhausting of the welding fumes will be required, especially during welding of the stainless-steel liner in the heater borings. Hot work permits (Albéa and/or Rio Tinto) are required for on-site welding.

The subsurface drilling work for OU3 will involve interior work, 2nd and 3rd shift work, and work near overhead enclosed electrical raceways and installed energized electrical equipment in the Albéa building. These tasks will require the following controls in addition to those noted in Section 4 of this HASP.

Interior Work: Since the Albéa facility will remain in operation during the work inside the plant, the following additional controls shall be followed:

1. Exhaust all gas-powered equipment to the outside and away from employee break areas, including drill rigs, blowers etc. A multi-gas meter and a P-Trak will monitor the breathing zone adjacent to and surrounding the drilling operations inside the facility to verify exhaust is properly vented outside. The multi-gas meter will run continuously over the shift to monitor for oxygen, carbon monoxide, and the lower explosive limit. The P-Trak will run continuously over the shift to monitor for ultrafine particulates.
2. During welding activities, a DustTrak will be used to monitor the effectiveness of the ventilation control by measuring airborne concentration levels of welding related smoke and fume in real time.
3. Limit workers to the project area, avoiding accessing plant operations areas as much as possible. In addition, Ramboll will provide safe passage through or around the project area for Albéa personnel, with safety warnings, as needed.
4. Barricade equipment and boring areas at the end of each shift and when unattended.
5. All personnel entering or working inside the Molding Room will require on-site electrical safety awareness training for working around energized equipment and electrical equipment that is under Lock-out/Tag-Out (LOTO). In addition, all personnel will be required to participate in the LOTO program that includes locking and tagging the gantry cranes for the duration of the work inside the Molding Room as well as locking and tagging the Treatment System during installation, as necessary.

Second/Third Shift Work: Due to the 2nd and 3rd shift work schedule, the following additional controls shall be followed:

1. Crews must be allowed a day of rest if switching between 1st and 2nd/3rd shift work.
2. Proper lighting must be maintained in exterior work areas after dark.
3. 2nd/3rd shift emergency contacts must be confirmed.
4. After dusk, workers will only leave building in teams of two or more (e.g., no conducting lone-worker tasks outside of building).
5. Appropriate scheduling must be developed to maintain "fit for work" condition of the on-site workers throughout the drilling/construction period.

Work near Indoor Albéa Overhead Enclosed Electrical Raceway: The overhead enclosed raceway (height from floor = 12 feet) reportedly carry 480 volts and cannot be de-energized during the Pre-design Investigation work without plant shutdown. Therefore, the following controls shall be followed:

A) Drill equipment used shall be limited to equipment with mast height of 11 feet or less when in the vicinity (1 ft) of the raceways (per Albéa general safety guidelines and see SPI 9 – Electrical Safety Non-Qualified, Section 5.5.4).

B) Driller will maintain a distance of at least 1 foot (per Albéa general safety guidelines) between the equipment and the enclosed raceways.

C) Two experienced spotters will monitor the movement of the mast during setup and lowering.

D) Flagging will be conducted in areas where the mast must be modified to 11 feet or less and to mark areas where the mast must not be raised to full height.

Previous work conducted inside the Albéa facility indicated that VOC concentrations ranging from approximately 2 to 15 ppm are present at various times within the facility. Passive air sampling was conducted over an 8-hour period on February 27, 2018 to evaluate the presence of VOCs due to routine facility operations. Isopropyl alcohol, toluene and ethyl acetate were detected at concentrations well below their respective TLVs (isopropyl alcohol: 200 ppm; toluene: 20 ppm; and ethyl acetate: 400 ppm). Based on current and past air sampling results, in-plant, shift-long VOC readings appear to be controlled to well below exposure limits, but due to the presence of VOCs resulting from facility operations, additional air monitoring procedures are detailed in Section 8.

Task 7 – Investigative-Derived Waste (IDW) Management

Investigative-Derived Waste (IDW) will be collected and categorized as non-hazardous or hazardous. Potentially hazardous IDW (soil cuttings) will be tested and disposed of within 90 calendar days of completing the field activities. Ramboll personnel may collect grab and composite soil samples for waste characterization. Soil will be collected using clean, decontaminated sampling tools or disposable tools and placed into unpreserved laboratory supplied jars. Following collection, samples will be held on ice and picked up via laboratory courier for waste disposal analysis. Ramboll personnel will wear appropriate personal protective equipment (PPE), such as nitrile gloves and safety glasses, during sample collection activities.

Non-hazardous IDW (normal trash) will be disposed of in a timely fashion during fieldwork. Further details related to IDW protocols related to vapor intrusion and installation activities are found in Section 11.3.

Task 8 – Oversight of Construction/Installation of Vapor and Liquid Treatment Systems

Oversight of Construction/Installation of Vapor and Liquid Treatment Systems includes observation of:

- Installation of conveyance piping and hoses, including working from heights and leak testing.

- Transport of packaged vapor treatment unit to west side of Albéa building, and electrical connection of the blower, chiller, heat exchanger etc.
- Operation of blower and pump systems.
- Handling of Granular Activated Carbon (GAC) and condensate water

Piping installation equipment installers must maintain a distance of at least 1 foot between the equipment and the enclosed raceways. (per Albéa general safety guidelines). In addition, two experienced spotters will monitor the movement of the piping installation equipment (scissor lifts) during installation of overhead vapor manifold lines.

All personnel entering or working inside the Molding Room will require on-site electrical safety awareness training for working around energized equipment and electrical equipment that is under LOTO. In addition, all personnel will be required to participate in the LOTO program that includes locking and tagging the gantry cranes for the duration of the work inside the Molding Room as well as locking and tagging the Treatment System during installation, as necessary.

Note: Excavation for installation of condensate water conveyance pipe at west driveway will also be conducted. Subsurface utility clearance will be required prior to excavation for the pipe install if to be placed below ground/payment surface. A H&S variance may be needed to excavate over the existing GWETS line.

Task 9 – Oversight of Installation of Heater Wells/VEWs and Associated Instrumentation, Wiring and Electrical Supply

Oversight of installation of the heater wells, VEWs, instrumentation and associated power supply includes the following:

- Driller to install heater can with power cabling and well screens in new borings inside the Albéa building.
- Electrical contractor to install power poles and bring new power lines/transformers to site, including bringing power to switch boxes.
- Electrician to install switch boxes and bring power to power panels for ISTR use and connect backup generator.
- Contractor to install temperature and pressure monitoring instrumentation.
- Contactor to use appropriate LOTO procedures as verified by the Ramboll site safety officer. Isolation permits (Rio Tinto) are required to document LOTO.

Ramboll personnel will provide oversight only and will not perform electrical activities. However, all personnel entering or working inside the Molding Room will require on-site electrical safety awareness training for working around energized equipment and electrical equipment that is under LOTO. In addition, all personnel will be required to participate in the LOTO program that includes locking and tagging the gantry cranes for the duration of the work inside the Molding Room as well as locking and tagging the Treatment System during installation, as necessary.

Task 10 – Oversight of ISTR Commissioning, Startup and Operation

Oversight of commissioning and system startup includes observations of:

- Contractor to run air and then vapors through the air treatment system.

- Contractor to run condensate liquid through the water treatment system and convey water to the GWETS.
- Contractor to heat the subsurface soils to 90ºC.
- Contractor's operator will conduct system checks, system sampling and system adjustments during operation.
- Contactor to use appropriate Lock-out/Tag-Out procedures, as needed to make system adjustments, as verified by the Ramboll site safety officer. Isolation permits (Rio Tinto) are required to document LOTO.

Task 11 – Process System Sampling and Water Transferring during ISTR Operation, including Hot Soil Sampling

Sampling activities during operation will be conducted by the Contractor and/or Ramboll and will include:

1. Sampling of vapor monitoring points and vapor extraction well heads by Tedlar™ bag and/or summa cannister.
2. Sampling of condensate water as needed for treatment/disposal, including on-site pH testing by GWTT.
3. Hot soil confirmation sampling. Hot soil sampling includes handling of sampling tubes at temperatures up to 90ºC and immersing them into an ice bath. Personnel must avoid looking down a borehole when the thermal treatment is on-going. Ramboll staff will not handle sampling tubes for logging and taking samples for analysis until after they have been in the ice bath and have a temperature of 50ºC or less. Additional PPE for this task will include: a thermometer, cold- and heat-resistant gloves and, if there is potential for steam, a face shield.

This task also includes coordination of the transfer of ISTR condensate water to the GWETS sump for treatment.

1.5 Site-Specific Requirements

The Ramboll Project Team will also comply with the requirements of Rio Tinto's Health, Safety, Environmental, Quality Management System and Critical Risk Management Program, and Albéa Facility requirements.

1.6 Applicable Standards

The methods and procedures prescribed in this HASP are intended to conform to established professional practices and applicable federal, state, and local occupational safety and health protection standards based on information that is currently available. Regulations serving as the technical compliance basis for this document may include but are not limited to the following:

- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Standards for Construction (29 CFR 1926).
  - Hazardous Waste Operations and Emergency Response (29 CFR 1926.65)
  - Hearing Protection (29 CFR 1926.101 and 29 CFR 1926.52)
  - Eye and Face Protection (29 CFR 1926.102)
  - Respiratory Protection (29 CFR 1926.103)
  - Working Over or Near Water (29 CFR 1926.106)

  - Material Handling Equipment (29 CFR 1926.602)
- U.S. Department of Labor, OSHA Standards for General Industry (29 CFR 1910).
  - Hazardous Waste Operations and Emergency Response (29 CFR 1910.120)
  - PPE General Requirements (29 CFR 1910.132)
  - Eye and Face Protection (29 CFR 1910.133)
  - Respiratory Protection (29 CFR 1910.134)
  - Head Protection (29 CFR 1910.135)
  - Foot Protection (29 CFR 1910.136)
  - Hand Protection (29 CFR 1910.138)
  - Medical Services and First Aid (29 CFR 1910.151)
  - Portable Fire Extinguishers (29 CFR 1910.157)
  - Hazard Communication Standard (29 CFR 1910.1200)
  - Control of Hazardous Energy (LOTO) (29 CFR 1910.147)
- U.S. Department of Labor, Recording and Reporting Occupational Injuries and Illnesses, (29 CFR 1904).

The following technical documents may have been utilized as references in the preparation of this HASP. However, the citation of these technical documents does not imply compliance with all aspects of these documents. The purpose of these citations is to aid in the interpretation of conflicting issues that may arise during the performance of site activities. The following technical documents may include but are not limited to:

- National Institute for Occupational Safety & Health (NIOSH)/OSHA/United States Coast Guard (USCG)/USEPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, (October 1985).
- U.S. Department of Health and Human Services (DHHS), NIOSH Sampling and Analytical Methods, DHHS (NIOSH) Publication 84-100.
- American National Standards Institute (ANSI), Emergency Eyewash and Shower Equipment, Z358.1 (1981).
- ANSI, Protective Footwear, Z41.1 (1983).
- ANSI, Practice for Occupational and Educational Eye and Face Protection, Z87.1 (1979).
- ANSI, Protective Headgear for Industrial Workers - Requirements, Z89.1 (1986).

2. IDENTIFICATION OF KEY PERSONNEL

An efficient on-site operation requires that all key personnel be identified and that their roles and responsibilities be clearly defined. Below is a discussion of the management structure for this project.

2.1 Project Organization

Ramboll serves as the Project Coordinator for the site. Ramboll is responsible for overseeing activities conducted by Ramboll personnel and Ramboll's subcontractors at the site. Ramboll also is responsible for oversight of compliance with this HASP in the field by Ramboll personnel. Ramboll subcontractors may plan, manage, and carry out activities at the site, including environmental investigation and remediation tasks, and will provide their own health and safety officers and HASP. As part of Ramboll's role as Site Coordinator, Ramboll will ensure that subcontractors are aware of the Ramboll HASP and its requirements.

2.2 Ramboll Personnel

Assigned functions of key Ramboll project team members and subcontractors are described in Tables 2 and 3, respectively, located at the end of this section. The applicable responsibilities for these individuals are as follows:

2.2.1 Principal in Charge/Project Manager

Responsibilities of the Principal in Charge (PIC) and the Project Manager (PM) include overall coordination of site activities. The PIC and the PM have overall accountability and responsibility for the safety of operations, the health and safety of personnel, and monitoring the work effort, schedule, costs, and communication. The PIC and PM will ensure that the activities of all Ramboll personnel comply with the approved work plans and will recommend or provide disciplinary action, as appropriate, if non-compliances occur.

These individuals will also provide the focal point for communications between the regulatory authorities; state and local community, on-site subcontractors, and Ramboll project staff. This liaison activity will provide a clear line of communication between all parties to minimize the chance for misconceptions concerning any aspect of the project.

Any and all recommended revisions or changes in the HASP will be reviewed by the PIC, PM and Project Health and Safety Coordinator prior to final approval by the Corporate Health and Safety Director.

2.2.2 Corporate Health Safety and Security Director

The Ramboll Corporate Health, Safety and Security Director (CHSSD) will oversee all issues related to health and safety and will have final approval authority for any deviations from Ramboll's SPIs.

2.2.3 Project Health and Safety Coordinator

The Project Health Safety and Security Coordinator (HSSC), along with the CHSSD are resources for the development of the site-specific hazard assessments and control mechanisms. For any changes/modifications/additions that may need to occur to the HASP, the HSSC and/or the CHSSD will be consulted. The CHSSD will make all final decisions regarding questions on the hazard assessment and/or the control mechanisms.

Any and all recommended revisions or changes in the HASP will be reviewed by the PIC, PM and HSSC prior to final approval by the CHSSD.

2.2.4 Site Safety Officer

For the purposes of this HASP, the Ramboll Site Safety Officer and Designated Site Supervisor may be the same individual. For a description of the responsibilities of the Site Safety Officer, see Section 2.2.5.

2.2.5 Site Supervisor

The Ramboll Site Supervisor is responsible for overseeing day-to-day site activities (as needed) performed by Ramboll and its subcontractors. The principal responsibility of the Ramboll Site Supervisor will be to coordinate and document all on-site work necessary to fulfill approved work plans. The Ramboll Site Supervisor and Site Health and Safety Officer may be the same individual.

The Ramboll Site Supervisor reports to the PIC, PM, and CHSSD. The Ramboll Site Supervisor is responsible for ensuring compliance with all aspects of the HASP; activities that they will perform include, but are not limited to: ensure safe work practices, control site access, establish work safety zones, ensure use of proper personal protective equipment (PPE), review planned site activities, implement safety procedures necessary to complete work safely, perform daily safety briefings, assist in on-site emergencies, and act as technical liaison to regulatory agency personnel. The Ramboll Site Supervisor will report all site-related injuries to the PIC, PM, HSSC and/or CHSSD, and to any other necessary authorities. The Ramboll Site Supervisor will ensure that all Site personnel understand their respective emergency response duties. In the instance of any emergency or non-emergency incidents concerning Site personnel, the Ramboll Site Supervisor will be contacted and will be responsible for communicating any information regarding Site safety conditions to rescue or emergency personnel. The Site Supervisor will ensure that all activities at the Site comply with the approved HASP.

Any person working on-site has the authority to stop work if any operation threatens the health and safety of on-site workers or the surrounding community. In the event that such a situation occurs, the Site Supervisor shall be notified immediately. Ramboll's Site Supervisor will update the Ramboll PIC and/or PM on all project-related health and safety issues as they arise.

The Ramboll Site Supervisor will be certified in first aid and cardiopulmonary resuscitation (CPR) by the American Heart Association, or equivalent. The Site Supervisor will also be HAZWOPER trained for site work in accordance with applicable regulations and participate in a medical surveillance program.

In the event of an emergency, the Ramboll Site Supervisor will also function as the Site Emergency Response Coordinator and will implement and coordinate emergency response procedures described in this HASP.

2.2.6 Designated Person

The Ramboll Designated Person is responsible for conducting the required due diligence prior to conducting SSC activities, as discussed in Section 4.2. For the purposes of this HASP, the term "Designated Person" may be synonymous with "Site Supervisor." The Ramboll Designated Person will have sufficient professional or technical training, knowledge, actual experience and authority to perform assigned duties at the level of responsibility allocated; understand any potential hazards related to the work/equipment, and; detect any technical defect or omissions, recognize health and safety implications caused by those defects/omissions, and specify a remedy to mitigate those implications.

2.2.7 Other Personnel

All other Ramboll personnel will be certified in first aid and CPR by the American Heart Association, or equivalent, and will also be HAZWOPER trained for site work in accordance with applicable regulations and participate in a medical surveillance program.

Ramboll's subcontractors, if needed, shall prepare their own company HASP, which shall specifically govern the work performed by its employees. The contractor's HASP shall be in conformance with Ramboll's HASP.

All Subcontractors will also provide a Health Safety and Security Coordinator (HSSC) who will assist Ramboll's Site Supervisor. The subcontractor HSSC will ensure that their personnel have received appropriate health and safety training and are participating in a medical surveillance program.

Table 2: Ramboll Personnel Contact Information

Personnel Telephone Roster			
Company/Title	Personnel	Office	Cell
Ramboll Project Director	Bruce Kennington	312-288-3834	312-953-9965
Ramboll HSEQ MS Coordinator	Alyssa Larson	303-382-5463	847-732-8656
Ramboll Project Engineer	Scott Tarmann	262-901-0093	262-853-9964
Ramboll Project Manager	Stan Popelar	312-288-3858	815-793-6442
Ramboll Site Supervisor	Michael Eddings	913-553-5929	785-250-3648
Ramboll Site Supervisor	Doug Burge	314-590-2963	314-378-8065
Ramboll Site Safety Officer	Nita Shinn	813-397-4730	904-947-0789
Ramboll Site Safety Officer	Adrian Ezeagu	609-243-9849	517-214-5732
Ramboll Global Director, Health and Safety	Jim Fox	315-956-6813	
Ramboll Health Safety and Security Coordinator	Jeff Parsons		315-391-0638
Client Contact	Luis Hidalgo		435-932-3955
Site Contact, Albéa	Russell Gladd	908-825-5231	908-674-1479

Table 3: Contractor/Subcontractor Contact Information

Contractor/Subcontractor Telephone Roster			
Company/Title	Personnel	Office	Cell
GWTT	Pat Biskey	973-983-0901	973-884-4120
TRS Group, Inc.			
Project Manager	Christopher Thomas	847-376-3691	360-560-4845
Site Health and Safety Officer	TBD		
GSE			
Project Manager	TBD		

3. HAZARD EVALUATION

The Project Hazard Analysis below identifies the hazards anticipated to be encountered by the project team based on the tasks presented in Section 1.4.

Table 4: Project Hazard Analysis

Chemical Hazards Present: ☐ None	☒ Flammable/combustible ☒ Compressed gas ☐ Explosive ☐ Organic peroxide ☐ Oxidizer ☐ Water reactive ☐ Unstable reactive ☒ Dust/Fumes/Particulates	☒ Corrosive ☒ Toxic ☐ Highly Toxic ☒ Irritant ☐ Sensitizer ☒ Carcinogen ☐ Mutagen ☐ Other:
Physical Hazards Present: ☐ None	☒ Heat ☒ Cold ☒ Walking/working surfaces ☒ Visible Dust ☒ Traffic/Vehicles ☒ Noise ☒ Other: Hot surfaces	☒ Ionizing radiation ☐ Non-ionizing radiation ☒ Electricity ☒ Severe Weather ☒ Poor lighting ☒ Overhead Hazards
Environmental/Mechanical Hazards Present: ☐ None	☒ Heavy machinery ☒ Trenching/excavation ☐ Docks-marine operations ☐ Docks-loading ☒ Drilling ☒ Forklifts ☐ Operations on Water ☒ Elevated heights ☒ Overhead/Underground utilities ☒ Confined spaces ☒ Power tools	☒ Cranes/Hoists/Rigging ☒ Ladders ☒ Scaffolding ☒ Manlifts ☒ Gas cylinders ☐ Roadway work ☐ Railroad work (Inactive rail line) ☒ Energized equipment ☒ Pressurized equipment ☒ Drums and containers ☐ Others:
Biological Hazards Present: ☐ None	☒ Animal/human fluids or blood ☒ Animal/human tissue(s) ☐ Poisonous/irritating plants ☐ Other:	☐ Contaminated needles ☐ Live bacterial cultures ☐ Insects/rodents/snakes ☐ Other:
Ergonomics Hazards Present: ☐ None	☒ Repetitive motion ☒ Awkward position ☒ Heavy Lifting ☒ Frequent Lifting	☒ Limited movement ☒ Forceful exertions ☒ Vibration ☐ Other:
Personal Safety/Security: ☐ None	☒ Personal safety ☒ Security issue ☐ Project site in isolated area ☒ Employees working alone ☐ Wild/Feral Animals	☒ Employees working early/late ☐ Potentially dangerous wildlife ☐ Guard or stray dogs in area ☐ No/limited cell phone service ☐ Other:

3.1 Specific Chemicals of Concern

The chemicals listed in Table 5 below includes the identification of chemical contaminants known and/or suspected of being present on-site, the affected media, known concentrations (if applicable), the Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV), and the Action Level (i.e., 50% of the PEL/TLV). In addition, Appendix A contains specific hazardous property information for commonly encountered chemicals, and a Safety Data Sheet (SDS) (or equivalent) is also included in Appendix A.

Table 5: Chemicals of Concern

Chemical	Environmental Media [1]	Highest Measured Concentration[2]	PEL / TLV[3]	Action Level[4]
1,1-Dichloroethene	GW	9.2 µg/L	NS / 5 ppm	2.5 ppm
cis-1,2-Dichloroethene	GW/SO	1.1 µg/L / 0.2 ppm	200 ppm / 200 ppm	100 ppm
Tetrachloroethene	GW/SO	0.23 µg/L / 0.076 ppm	100 ppm / 25 ppm	12.5 ppm
trans-1,2-Dichloroethene	GW	1.7 µg/L	200 ppm / 200 ppm	100 ppm
Trichloroethene	GW/SO	4,000 µg/L / 9,500 ppm	100 ppm / 10 ppm (25 ppm STEL)	5 ppm (12 ppm STEL)

Notes:

[1] Codes for environmental media: **SL**=Sludge; **GW**=Ground Water; **SW**=Surface Water; **LW**=Liquid Waste; **SO**=Soil; **A**=Air; **OTH**= Other (Specify)

[2] This table presents the COCs that were identified in ENVIRON's 2007 the Remedial Investigation Report (SIR) for soil and groundwater. The soil data presented is from the 2007 SIR report and the groundwater data presented is from Ramboll's Third Annual (2016) MNA Report.

[3] PEL: Permissible Exposure Limit / TLV: Threshold Limit Value, use appropriate PEL which would be country or state specific or if one is not available may be from a recognized source.

mg/m³: milligrams per cubic meter
mg/kg: milligrams per kilograms
ug/L: micrograms per liter
ppm: Parts per million
%: Minimum percent allowed for personal entry into a space
NS: No Standard

[4] The action level is 50% of the most restrictive PEL/TLV for each chemical compound.

3.2 Chemical Preservatives

During some of the sampling tasks, field personnel will handle sample jars or bottles, which may be preserved with one of the following chemical preservatives: hydrochloric acid (HCl), nitric acid (HNO_3), sodium hydroxide (NaOH), sulfuric acid (H_2SO_4), and zinc acetate ($C_6H_6O_4Zn$). Prior to handling preserved sample jars/bottles, the field team will review the corresponding SDS (see Appendix A) and don the appropriate PPE as listed in the SDS and noted in Tables 9 and 10 below. The field personnel will take care when handling the preserved sample jars/bottles so as not to spill the preservatives on themselves or the ground. If sample bottles are broken upon arrival at the site, the field team will don appropriate PPE and dispose of the broken bottles. The field team will not store unused preserved sample jars/bottles after the conclusion of a sampling event; the unused jars/bottles will be sent back to the laboratory via courier.

4. HAZARD CONTROLS

In order to conduct a Task in the safest possible manner, the hazard(s) associated with a Task need to be identified so that appropriate hazard control(s) can be implemented and used by personnel conducting these Task(s). This process is called a "Job Hazard Analysis (JHA) or "Job Safety Analysis" (JSA). To aid in the JHA/JSA process, the projected Task(s) (as outlined in Section 1.5) for which the anticipated hazard is expected to apply, are identified. A "Relative Hazard/Risk Rating" is also provided in order to identify which hazards pose the greatest risk to personnel but more importantly, what hazard controls should be implemented.

Table 6: Control of Hazards Summary

Task Number(s)	Hazards	Relative Hazard /Risk Rating*	Hazard Controls Appendix and/or HASP Section
3, 4, 6, 7, 9, 10, 11	Chemical Hazards	NA☐ Low☒ Medium☐ High☐	B1 Chemical
6, 7, 9	Dust/Fumes/Particulates	NA☐ Low☐ Medium☒ High☐	B2 Dust/Particulates/Fumes See Section 1.4 for exhaust controls during OU3 work
1, 2, 3, 6, 7, 8, 9, 10, 11	Job Zone Control	NA☐ Low☐ Medium☒ High☐	B3 Job Zone Control
2-11	Heat	NA☐ Low☐ Medium☒ High☐	B4 Heat
2-11	Cold	NA☐ Low☒ Medium☐ High☐	B5 Cold
1-11	Severe Weather	NA☐ Low☒ Medium☐ High☐	B6 Severe Weather
2-11	Walking/Working Surfaces	NA☐ Low☐ Medium☒ High☐	B7 Safe Walking Surfaces and Work Areas
6, 7, 8, 9,10	Noise	NA☐ Low☐ Medium☒ High☐	B8 Noise
N/A	Unexploded Ordinances	NA☒ Low☐ Medium☐ High☐	B9 Unexploded Ordinances
N/A	Closed/Abandoned Mines	NA☒ Low☐ Medium☐ High☐	B10 Closed/Abandoned Mines
1-11	Operational Facility (Traffic/Docks/Loading)	NA☐ Low☐ Medium☒ High☐	B11 Operational Facility
6, 8, 9	Ionizing Radiation	NA☒ Low☐ Medium☐ High☐	B12 Radiation
N/A	Non-ionizing Radiation	NA☒ Low☐ Medium☐ High☐	B12 Radiation
N/A	Confined Spaces[1]	NA☒ Low☐ Medium☐ High☐	B13 Confined Spaces & Section 9
4, 6, 8, 9, 10	Live Electrical Equipment	NA☐ Low☐ Medium☒ High☐	B14 Live Electrical Equipment
1-3, 6-11	Poor Lighting	NA☐ Low☐ Medium☒ High☐	B7 Safe Walking Surfaces and Work Areas
6, 8, 9	Overhead Hazards	NA☐ Low☐ Medium☒ High☐	B15 Overhead Hazards See Section 1.4 for OU3 work.
N/A	Work Near Railroads[2]	NA☒ Low☐ Medium☐ High☐	B16 Work Near Railroads

Table 6: Control of Hazards Summary

Task Number(s)	Hazards	Relative Hazard /Risk Rating*	Hazard Controls Appendix and/or HASP Section
1-3, 6-11	Traffic Management (Vehicle, pedestrian interference)	NA☐ Low☐ Medium☒ High☐	B17 Traffic Management
3, 6, 7, 8, 9	Heavy machinery/drill rigs	NA☐ Low☒ Medium☐ High☐	B18 Heavy Machinery/Drill Rigs
3, 6, 8, 9	Heavy machinery/drill rigs in Albéa building near overhead enclosed raceways, OU3	NA☐ Low☐ Medium☒ High☐	B18 Heavy Machinery/Drill Rigs. See Section 1.4 for specific controls
8	Trenching/Excavation	NA☐ Low☒ Medium☐ High☐	B19 Trenching/Excavation
1, 2, 3, 7, 11	Vehicle use	NA☐ Low☐ Medium☒ High☐	B20 Vehicle Use
N/A	Work near/on water	NA☒ Low☐ Medium☐ High☐	B21 Work Near/On Water
6,7, 8, 9, 10	Elevated heights (<4ft)	NA☐ Low☒ Medium☐ High☐	B22 Working from Heights (<4 feet)
6, 7, 8, 9	Elevated heights (>4ft)	NA☐ Low☐ Medium☒ High☐	B23 Working from Heights (>4 feet)
6, 8, 9, 10	Overhead/underground utilities	NA☐ Low☒ Medium☐ High☐	B24 Overhead/Underground Utilities & Sections 4.2-4.3
6, 8, 9,10, 11	Overhead/underground utilities in Albéa building, OU3	NA☐ Low☐ Medium☒ High☐	B24 Overhead/Underground Utilities & Sections 4.2-4.3/ See Section 1.4 for specific controls.
6, 7, 8, 9, 10, 11	Powered hand tools	NA☐ Low☒ Medium☐ High☐	B25 Electrically Powered Equipment and Tools
4, 6, 7, 8, 9, 10	Electrically powered equipment	NA☐ Low☐ Medium☒ High☐	B25 Electrically Powered Equipment and Tools
6, 7, 8, 9, 11	Cutting devices/tools	NA☐ Low☒ Medium☐ High☐	B26 Cutting Devices/Tools
6, 8, 9	Lifting operations (cranes, rigging)	NA☐ Low☒ Medium☐ High☐	B27 Lifting operations (cranes, rigging)
4, 6, 8, 9, 10 (oversight only)	LO/TO (electrical, pressure, etc)	NA☐ Low☐ Medium☒ High☐	B28 Lock Out/Tag Out (LO/TO) (electrical/pressure)
4, 6, 7, 8, 11	Drums, cylinders, containers	NA☐ Low☒ Medium☐ High☐	B1 Chemical
4-11	Material handling, ergonomics	NA☐ Low☐ Medium☒ High☐	B29 Material Handling/Ergonomics
1-11	SIMOPS (Simultaneous Operations)	NA☐ Low☐ Medium☐ High☒	B30 SIMOPS
1-11	Animal/human fluid/blood/tissue	NA☐ Low☒ Medium☐ High☐	B31 Bloodborne Pathogens

Table 6: Control of Hazards Summary

Task Number(s)	Hazards	Relative Hazard / Risk Rating*	Hazard Controls Appendix and / or HASP Section
2, 3	Poisonous/irritating plants	NA☐ Low☒ Medium☐ High☐	B32 Plants and Animals
2, 3	Contaminated needles	NA☐ Low☒ Medium☐ High☐	B31 Bloodborne Pathogens
10	Live bacterial cultures (Legionella)	NA☒ Low☐ Medium☐ High☐	B31 Bloodborne Pathogens
2-11	Insects/rodents/snakes	NA☐ Low☒ Medium☐ High☐	B32 Plants and Animals
2-11	Ticks, mosquitos	NA☐ Low☒ Medium☐ High☐	B32 Poisonous Plants, Animals, and Insects
1-11	Security issues	NA☐ Low☐ Medium☒ High☐	B33 Job Safety
N/A	Isolated area	NA☒ Low☐ Medium☐ High☐	B34 Personal Safety
1-11	Employees working alone	NA☐ Low☒ Medium☐ High☐	B35 Working Alone
N/A	Seasonal hunting	NA☒ Low☐ Medium☐ High☐	B36 Seasonal Hunting and Dangerous Wildlife
1-11	Employees working early/late	NA☐ Low☐ Medium☒ High☐	B34 Personal Safety See Section 1.4 for specific 2nd shift controls for OU3.
N/A	Potentially dangerous wildlife	NA☒ Low☐ Medium☐ High☐	B36 Seasonal Hunting and Dangerous Wildlife
2, 3	Guard/stray dogs	NA☐ Low☒ Medium☐ High☐	B33 Job Safety
N/A	No/limited cell phone service	NA☒ Low☐ Medium☐ High☐	B34 Personal Safety B35 Working Alone
6, 8, 9	Fire and fumes from welding	NA☐ Low☐ Medium☒ High☐	B2 Dust/Particulates/Fumes See Section 1.4 for exhaust and fire controls during OU3 work
11	Hot soil cores/sampling	NA☐ Low☒ Medium☐ High☐	Samplers are to not touch cores until after they have been in ice bath.

Notes:

A single hazard may be listed under several Tasks. In this case, use the highest Severity ranking of the tasks evaluated as the overall ranking.

[1] Confined spaces are present onsite. **Ramboll personnel are not authorized to enter confined spaces and must not break the plane of any entry point to a confined space with any body part.** Ramboll personnel must use tools to access the interior of a confined space.

[2] Railroad is abandoned.

***Relative Hazard/Risk Rating**

When evaluating a Task against a specific hazard, the evaluator should:

A. Determine how frequently you will be conducting the Task and generally be exposed to the Hazard while on-site;

B. Determine the duration (i.e., the amount of time) you will spend conducting the Task; and

C. Determine the Severity that the Task/Hazard may cause using Table 7. When assessing the severity, assume the hypothetical injury was a result of the task being conducted improperly and that PPE was not being worn:

- **Minimal Severity** would require first aid and/or the property/equipment damage is limited to minor wear and tear, scratches, dents (still functional);
- **Moderate Severity** requires professional medical attention and/or the property/equipment damage necessitates repair but not replacement; and
- **High Severity** requires immediate medical attention/life threatening and/or the property/equipment damage is significant and requires replacement.

NOTE: A single hazard maybe listed under several Tasks. In this case, use the highest Severity ranking of the tasks evaluated as the overall ranking.

Table 7: *Relative Risk Rating Decision Table

The Hazard…	Has No Severity	Has Minimal Severity	Has Moderate Severity	Has High Severity
Is Not Present (i.e., 0% of your on-site time does not expose you to this Hazard)	NA	NA	NA	NA
Is Rarely Present (i.e., <25% of your on-site time exposes you to this Hazard)	NA	LOW	LOW	MED
Is Sometimes Present (i.e., 25% - <50% of your time exposes you to this Hazard)	NA	LOW	MED	HIGH
Is Frequently to Constantly Present (i.e., 50% to 100% of your time exposes you to this Hazard)	NA	MED	HIGH	HIGH

4.1 General Site Safety

All activities will be conducted in a manner that minimizes hazards and employee exposures to such hazards. The following are some general safety rules that must be followed while on site:

- All personnel who perform on site operations with the potential for exposure to hazardous substances are required to meet personnel training requirements and medical surveillance criteria, which are described in this site health and safety plan.
- All hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of in accordance with accepted material handling procedures.
- Personnel will wear personal protective equipment as required.
- All work on site, will be planned and supervised by the appropriate personnel to prevent injuries.
- All injuries and accidents will be reported.

- Supervisors will ensure that their employees observe and obey all safety rules and regulations required for the safe conduct of work.
- Alcoholic beverages and illegal drugs will not be allowed on-site. Possession of either will be grounds for disciplinary actions.
- No employee will be assigned to a task without first having been instructed on proper methods of carrying out the task.
- All posted safety signs will be obeyed.
- Space around on-site emergency and fire-fighting equipment will be kept clear.
- All trash and discarded materials will be staged in an orderly fashion and regularly removed from the site.
- Approval to perform work operations alone must be preapproved by the site PM and/or PIC and a communication plan must be established.
- Smoking, eating, drinking, and chewing gum or tobacco will not be permitted within the work zones and personnel will follow applicable decontamination procedures prior to eating, drinking, and/or smoking.
- Personnel should keep track of weather conditions and wind direction to the extent they could affect potential exposure to airborne contaminants or create hazardous conditions.
- Personnel should be alert to any abnormal behavior on the part of other workers that might indicate distress, disorientation, or other ill effects.
- Personnel should never ignore symptoms that could indicate potential exposure to chemical contaminants. These should be immediately reported to their supervisor or the Site Health and Safety Officer.
- Visible indicators of potentially immediate danger to life and health (IDLH) conditions include:
    A. Large containers and tanks that must be entered.
    B. Enclosed spaces such as buildings or trenches that must be entered.
    C. Potentially explosive or flammable situations (indicated by bulging drums, effervescence, gas generation, or instrument readings).
    D. Extremely hazardous materials (such as cyanide, phosgene, or radiation sources).
    E. Visible vapor clouds.
    F. Areas where biological indicators such as dead animals or vegetation are located.

In addition, the Ramboll site safety officer must verify appropriate LOTO procedures are used by the Contractor during installation of heater wells/VEWs and associated instrumentation, wiring and electrical supply and during ISTR commissioning, start-up and operation. Isolation permits (Rio Tinto) are required to document LOTO. Further, all personnel entering or working inside the Molding Room will require on-site electrical safety awareness training for working around energized equipment and electrical equipment that is under LOTO. In addition, all personnel will be required to participate in the LOTO program that includes locking and tagging the gantry cranes for the duration of the work inside the Molding Room as well as locking and tagging the Treatment System during installation, as necessary.

4.2 Specific Subsurface Clearance (SSC) Requirements

The hazards posed by the presence of underground and overhead services are significant. Where there is a requirement for ground penetrating activity, the work shall be thoroughly vetted prior to commencing subsurface work. No intrusive work is to be conducted until the hazards associated with the possible presence of underground and overhead services have been properly identified, and safe locations for intrusion marked and agreed upon. This applies to any intrusive site work (i.e., any work which will involve the disturbance or penetration of the ground or manmade surface by mechanical or manual means, INCLUDING: trial pit excavations, borehole excavations (e.g., shell and auger, rotary, hydraulic, sonic, or percussive drilling), gas spiking, manual excavations, hand digging, intrusion into vertical, indoor, or below ground surfaces, and/or any other on-site activity where disturbance of the ground surface is required). If conducting intrusive activities, the following tasks must be completed **and documented** prior to initiating ground disturbance activities (each is summarized below).

4.2.1 Historical Site Information Review

The Site Supervisor will obtain the most recent as-built drawings and/or site plans (including underground storage tank (UST), product and vent lines), as available, and will consider requesting any other site plot plans, surveys, photographs, and information that might be instructive from the client or other sources. Site information that should be reviewed is specified below in Table 8, SSC Project Planning Checklist.

4.2.2 Plot Plan

The Site Supervisor will develop a plot plan that accurately reflects all available information and site conditions as accurately as possible, including the number, locations, and alignments of facilities, pipelines, or utilities. The plot plan shall be updated as SSC activities commence to properly capture site conditions or visual indicators. Intrusive activities shall not proceed without an updated plot plan or drawing.

4.2.3 Pre-Marking Ground Disturbance Locations

Whenever feasible, ground disturbance locations and/or areas shall be pre-marked using white stakes, white paint, or white flags (or black in cases where snow is on the ground) prior to the public and/or private utility mark-outs. Pre-marking provides the line locators with visual boundaries as guidelines in clearing locations and placing marks.

4.2.4 Line Location Services:

In areas where public and private resources are available, **Ramboll will contact both public and private utility locate services for any project that involves intrusive activities.** In order to give line operators sufficient time to respond to a request to locate, a minimum of 72 business hours is required prior to the planned start of work. In the event that the driller/excavator retains these services, Ramboll will conduct a follow-up to confirm utility locate information.

The Site Supervisor will meet directly with the private locator and provide them with location plans, if possible. If an on-site meeting with the private locator is not possible, the Site Supervisor MUST contact the private locator so that they understand the scope of the proposed subsurface work and the extent of their activities.

4.2.5 Site Walkover-Visual Indicators

The Site Supervisor MUST conduct a site walk-over and complete the SSC Field Checklist in Appendix C for all projects that involve ground disturbance. The site walk-over and visual inspection is most effective when completed during locating activities, but, at a minimum, must be completed PRIOR to ground

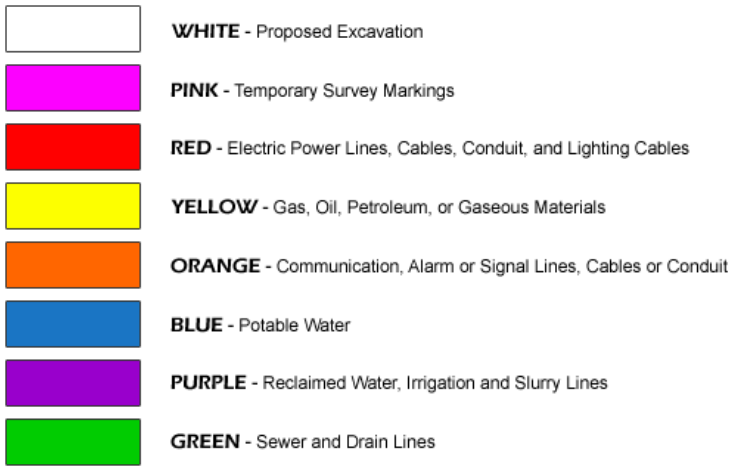
disturbance. The main intent of the SSC Field Checklist is to identify above ground indicators which may identify the potential existence of subsurface issue. It will also be used to confirm that common utilities have been accounted for, located and verified. Any potential underground utilities should be marked on a site plot plan and the site walkover should be documented utilizing Ramboll's SSC Field Checklist.

4.2.6 Utility Mark-Out

All known pipelines and utilities, as noted on the plot plan, pipeline map, or drawing that pass within the search zone must be located, identified, and marked to indicate location and alignment.

A qualified and competent line locator shall conduct line-locating practices utilizing available pipeline maps or plot plans for all areas within the search zone. Direct connection (clamping on) to all possible nearby underground services should be undertaken whenever possible to increase the success rate/reliability in locating. **The specific ground penetration location must be cleared to the edge of the critical zone** (a 5-foot or 1.5-meter area surrounding intrusive locations/areas in every direction) using a search and sweep method to verify maximum detection capabilities.

If anticipated services are not identified or located (anticipated services will be listed in Table 8), drilling or ground disturbance will not be conducted until the service is visually identified. Commonly used utility mark-out colors and identifiers are listed below:



Upon completion of their work (whether the Site Supervisor is on-site or not), the private locator MUST contact the Site Supervisor to present their results. In addition to providing the Site Supervisor with an overall summary of their work, **they must also inform the Site Supervisor of any unique circumstance(s) which limited their ability in locating the potential presence of underground utilities (e.g., the existence of overhead electrical lines); if they encountered any abnormalities (e.g., concrete surfaces with reinforced rebar); and/or any other condition which may have diminished the validity of their results and efforts.**

Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the area in question and contact the PM and/or PIC.

4.2.7 Clearance of Ground Disturbance Locations & Critical Zones

After anticipated utilities have been located and marked, the Site Supervisor, the PM, and/or the PIC should use the available information along with regulatory requirements and project objectives to select final ground disturbance locations.

Each specific ground penetration location must be cleared to the edge of the critical zone (a 5-foot or 1.5-meter area surrounding intrusive locations/areas in every direction) using a search and sweep method to verify maximum detection capabilities. The Site Supervisor will ensure that all detected services and those featured on location plans are outside of the critical zone of EACH location where intrusive work will occur, using a sweep and search method.

The critical zone takes into account minimum tolerance distances from facility lines (which vary by location) and uncertainties introduced by on-site conditions, human factors, and equipment. **No intrusive activities shall take place within a critical zone where there are utilities or visual indicators.** When known utilities intersect ground disturbance critical zones, boring and/or excavation location criteria should be reevaluated by the Site Supervisor and PM, and if possible, moved to a pre-cleared alternate location.

In the event that work is required to be conducted in a critical zone containing a marked utility or visual indicator, approval MUST be obtained from the PIC, PM, and CHSSD prior to ground penetrating activities.

4.2.8 Overhead Lines

The Site Supervisor will ensure that any ground penetrating activities are located a minimum of 28 feet (9 meters) horizontally from any overhead electric cable supported wooden poles, or 50 feet (15 meters) horizontally in the case of those supported on metal poles/towers. Where this cannot be achieved, the Site Supervisor will contact the relevant electricity provider for guidance as well as the PIC/PM and CHSSD.

In addition, the Molding Room inside the Albéa facility contains overhead enclosed electrical raceways that are approximately 12 feet in height from the floor and reportedly carry 480 volts. The raceways cannot be de-energized without plant shutdown. The following controls shall be followed:

- Drill equipment used shall be limited to equipment with mast height of 11 feet or less when in the vicinity (1 ft) of the raceways (per Albéa general safety guidelines and see SPI 9 – Electrical Safety Non-Qualified, Section 5.5.4).
- Driller will maintain a distance of at least 1 foot (per Albéa general safety guidelines) between the equipment and the enclosed raceways.
- Two experienced spotters will monitor the movement of the mast during setup and lowering.
- Flagging will be conducted in areas where the mast must be modified to 11 feet or less and to mark areas where the mast must not be raised to full height.
- Piping installation equipment installers must maintain a distance of at least 1 foot between the equipment and the enclosed raceways (per Albéa general safety guidelines). In addition, two experienced spotters will monitor the movement of the piping installation equipment (scissor lifts) during installation of overhead vapor manifold lines.

4.3 SSC Summary

If the tasks presented in this HASP involve ground penetrating work, Table 8 and the specific procedures outlined in Section 4.2 are applicable and will be followed. Table 8 summarizes the steps required to be completed, including justification of any exceptions. This table will be completed in its entirety prior to conducting subsurface work. If certain requirements are not applicable, a reason will be provided for exemption.

The SSC Project Planning Checklist (Table 8) has been completed by the HASP preparer and will be used as a guideline for the anticipated SSC activities. Planned and proposed dates for activities have been included by the HASP preparer, and information will be updated as it become available. If field practices differ from plans proposed and documented on the SSC Project Planning Checklist (like walkover dates or historical documents reviewed), it is the Site Supervisor's responsibility to complete an updated SSC Project Planning Checklist to reflect these changes. Any deviations from these requirements must be documented and approved prior to the commencement of ground disturbance activities.

Table 8: Subsurface Clearance (SSC) Project Planning Checklist

Subsurface Clearance (SSC) Pre-Project Planning Checklist Document the steps that must be followed and justify any exceptions. This checklist MUST be completed in its entirety.				
SSC Requirements	Yes	No	NA	Comments
Prequalification of Contractor for capability of performing utility locate (See Section 4)	☒	☐	☐	General Contractor for site work will be responsible for public and private utility locate. Ramboll will use this table and Appendix C as guides to verify proper procedures. Geod Corporation has been pre-qualified.
"Designated Person" for SSC work assigned (must be on-site)	☒	☐	☐	Name of Designated Person*: Michael Eddings, Adrian Ezeagu, Nita Shinn, or Doug Burge Signature of Designated Person: *The Designated Person will provide oversight to the Contractor that will be conducting the SSC work.
Historical Site Information Review	☒	☐	☐	Aerial photographs and historic site utility maps will be reviewed prior to the private utility locate.
Development of site-specific plot plan	☒	☐	☐	Plot Plan will be included as utilities are located.
Ground penetrating location marked prior to locate(s) and alternate locations chosen	☒	☐	☐	Location of planned excavations areas will by marked out by Cascade/TerraTherm or Ramboll and cleared by the private utility locator contractor prior to intrusive activities.
Service notifications provided to clear/locate public utilities	☒	☐	☐	Not less than 72 hours prior to planned intrusive activities, Ramboll will coordinate with the contractor (Cascade Environmental) to clear public utilities at the site. To document this clearance of public utilities, the following information will be recorded: List companies notified for public locate: TBD List who contacted One Call: TBD List One Call #: TBD List locate ticket #: TBD
Private locate contracted for on-site utilities	☒	☐	☐	Will be performed prior to subsurface activities.
Designated Person present during private locating	☒	☐	☐	A Designated Site Supervisor will be present during the private locate

Subsurface Clearance (SSC) Pre-Project Planning Checklist Document the steps that must be followed and justify any exceptions. This checklist MUST be completed in its entirety.				
Underground utilities identified prior to start of intrusive activities as reasonably feasible	☒	☐	☐	Underground utilities will be identified to the extent available using private/public locators, and marked in the field to designate their location. See Section 1.4 for overhead power precautions.
Site walkover conducted to assess utility locations, visual indicators and complete SSC Field Checklist	☒	☐	☐	The Ramboll Site Supervisor will conduct a walk-over of planned excavation areas, complete the SSC Field Checklist, and discuss the review of SSC inspections as part of the daily toolbox safety meetings and prior to the initiation of intrusive activities
Ground penetration locations(s)/area(s) and Critical Zones (i.e., the 5ft or 1.5m distance surrounding intrusive activities in every direction) cleared	☒	☐	☐	The critical zone surrounding each ground disturbance location will be cleared and the suspected location of below-ground utilities will be marked in the field. The report of the subsurface clearance activities will be reviewed by the Contractor and the Ramboll Site Supervisor prior to any intrusive activities at the site.

5. PERSONNEL TRAINING REQUIREMENTS

All personnel performing on-site operations with the potential for exposure to hazardous substances or health hazards will meet the personnel training requirements in accordance with applicable regulations. The training policies and procedures ensure that personnel can recognize hazards, understand emergency response procedures, and have the knowledge necessary to enable them to perform their assigned jobs in a manner that ensures employee and public safety. Completion of appropriate health and safety training, as described below, and participation of medical surveillance will be required to gain access to areas of active field work. Required, documented training includes initial 40-hour health and safety training, 8 hours of annual refresher training, supervised field experience, first aid training, and CPR certification.

Specifically, any employee who is or is expected to be directly involved with intrusive sampling of contaminated environmental media or other sampling activities that could reasonably lead to chemical exposure has completed appropriate training, including but not limited to 40-hour HAZWOPER (and 8-hour refresher training), respiratory protection, first aid, and CPR training.

5.1 Initial Training

1. Basic Health and Safety Training

A minimum of 24 hours of initial health and safety training off-site is required to obtain access to areas of active field work. All personnel engaged in or supervising activities in the areas of active field work will have a minimum of 40 hours of initial health and safety training off-site, in accordance with applicable regulations. The Ramboll personnel who will be working at the site have received 40 hours of initial health and safety training.

2. Supervised Field Experience

All personnel with 24 hours of initial health and safety training are also required to have a minimum of 1 day of field experience under the direct supervision of an experienced supervisor. Personnel with 40 hours of initial health and safety training are required to have a minimum of 3 days of field experience under the direct supervision of an experienced supervisor. The Ramboll personnel who will be working at the site have received at least 3 days of field experience under the direct supervision of an experienced supervisor.

3. Supervisor Training

All on-site managers and supervisors directly responsible for, or who supervise personnel engaged in invasive site activities, have received the initial 40-hour health and safety training and at least 8 additional hours of specialized off-site training consistent with in accordance with applicable regulations. This specialized training included topics such as, but not limited to, regulatory compliance, management of on-site health and safety hazards and recognition of special personnel training needs. The Ramboll Site Supervisor has received 8 additional hours of specialized health and safety training.

4. Health and Safety Officer Training

Health and safety officers will be trained to a level required by their job function and responsibility. This will include training in implementation of HASPs and compliance with applicable health and safety requirements.

5. First Aid and CPR Training

Ramboll personnel will maintain first aid and CPR training as certified by the American Heart Association (or equivalent) to render first aid and CPR.

5.2 Refresher Training

All personnel who have received 40 hours of initial health and safety training will receive 8 hours of refresher training annually, as specified in accordance with applicable regulations. Topics to be covered in this training program will include those specified in the initial 40-hour health and safety training and/or those specified in the supervisory training course, as well as a critique of incidents that could serve as training examples.

Project-specific refresher training will be provided when the project scope is changed and/or when the hazards change.

5.3 On-Site Training

a. Site Safety Briefings

Site safety briefings will be conducted prior to the start of each work day or work shift to discuss health and safety issues, changes in work procedures, exposure incidents and other relevant information. Prior to each change in operations, the meetings will address PPE use and maintenance, physical safety hazards from machinery, protection from chemical hazards, decontamination procedures, protection from heat/cold stress and specific safety requirements associated with the new operations. During safety meetings, on-site personnel qualified to perform first aid and CPR will be identified. Changes to the HASP will be reviewed during the morning safety briefing. A record of the meeting will be written daily and signed by all participants and included in Section 13.0 of this HASP.

b. Visitor's Briefing

Visitors will not be permitted to enter areas of active field work unless documentation of training, as described above, is presented to the Ramboll Site Supervisor. All visitors will be provided with applicable site-specific information including but not limited to hazard recognition, personnel hygiene and site safety rules, use of PPE, and emergency response procedures. Visitors requesting on-site access to areas of active field work will be required to review and sign off on the HASP to ensure understanding and compliance with the provisions in the HASP. All personnel, contractors, and site visitors will receive information contained in this HASP and any site-specific hazard awareness prior to entry into the area of active field work, as applicable. The training will ensure that personnel can recognize hazards, understand emergency response procedures, and have the knowledge necessary to enable them to perform their assigned jobs in a manner that ensures employee and public safety. All personnel will be required to sign an attendance sheet (see section 13.0 in this HASP) verifying that they received and participated in a training briefing. Individuals refusing to sign the sheet will not be allowed to enter the area of active field work.

5.4 Hazard Communication

Compliance with Hazard Communication Standard is required for work at this site. SDSs for select chemicals of concern (COCs) are included in Appendix A. Personnel have received training for the identification of hazards associated with the materials in use and the safe use of these materials, as applicable. Any hazardous chemical products brought to the site (other than standard fuels) for use during field activities must be reviewed by the Site Supervisor. Subcontractors are responsible for having their own hazard communication program. Subcontractors will supply SDS to the Site Supervisor for all products to be used on-site.

The following procedures related to hazard communication are applicable to this site. Personnel will be briefed on this program.

5.4.1 Container Labeling

All containers received on site will be inspected to ensure the following: (1) All containers will be clearly labeled as to the contents; (2) the appropriate hazard warnings will be noted; and (3) the name and address of the manufacturer will be listed.

All drums or bins to be shipped off the site will have a label affixed with the following information: (1) the identity of the waste generator, (2) the boring, well, or excavation identification and sample depth, (3) the waste matrix (e.g., soil, water, product), and (4) the date of waste generation.

5.4.2 Employee Training & Information

Prior to starting work, each employee will attend a health and safety orientation and will receive information and training on the following:

1. An overview of the requirements contained in the Hazard Communication Standard;
2. Hazardous chemicals present in their workplace operations;
3. Location and availability of a written hazard communication program;
4. How to read labels and review SDSs to obtain appropriate hazard information;
5. Locations of SDS files and the hazardous chemical inventory;
6. Physical and health effects of the hazardous chemicals;
7. Methods and observation techniques used to determine the presence or release of hazardous chemicals;
8. How to lessen or prevent exposure to these hazardous chemicals through usage of control/work practices and personal protective equipment; and
9. Emergency procedures to follow if they are exposed to these chemicals.

Ramboll employee(s) will inform its subcontractor(s) about the hazardous chemicals brought on-site by Ramboll; and likewise, subcontractors shall inform Ramboll employees about the same.

Further, all personnel entering or working inside the Molding Room will require on-site electrical safety awareness training for working around energized equipment and electrical equipment that is under LOTO. In addition, all personnel will be required to participate in the LOTO program that includes locking and tagging the gantry cranes for the duration of the work inside the Molding Room as well as locking and tagging the Treatment System during installation, as necessary.

5.5 Disciplinary Actions

In the event that personnel do not follow the health and safety rules and/or are conducting operations that are hazardous to themselves or their fellow workers, disciplinary actions will be implemented in accordance with Ramboll's policies.

5.6 Incident Reporting

Each subcontractor is responsible for maintaining injury and illness records in accordance with applicable regulations and supplying Ramboll with applicable records in a timely fashion upon request. With respect to incidents, the following types of EHS incidents are to be reported:

- All employee injuries and illnesses that include first aid, doctor/hospital visits which may or may not involve restricted work and/or lost time;
- Environmental incidents and exposures, such as spills or other unplanned releases to the environment or nonconformance with operating procedures;
- All evacuations (false or real);
- Any Property damage;
- Near miss incidents which could have resulted in an injury, an accident, environmental impact or significant loss of facilities;
- Public/third party liability incidents that involve injury, illness or property damage due to the actions of any non-Ramboll employee arising out of, or in connection with the Ramboll's contracted scope of work, operations, products, or premises.

As a rule of thumb, all of the incident types outlined above MUST be communicated by the Ramboll Site Supervisor to either the PIC/PM and the CHSSD and/or HSSC immediately following the incident, either in person or via phone, e-mail, or text messaging. The contacted person will then ensure that the other core project members are informed either in person or via phone, e-mail, or text messaging, regardless of time of day. As soon as possible after the incident but no later than 72 hours after the event, the first page of the Incident Investigation Report form will be completed by the Site Supervisor or his/her designee and sent to the core project members (i.e., the PIC/PM, CHSSD, and HSSC), for preliminary root cause analysis. The root cause analysis will not be deemed complete until input from all individuals involved in the incident, applicable witnesses, and input from the core team has been obtained. Similarly, the implementation of any corrective/preventive actions will NOT be implemented until input from the CHSSD (and others as necessary) has been obtained.

6. MEDICAL SURVEILLANCE AND RECORD KEEPING

The goals of the medical surveillance program are to monitor the health of potentially exposed personnel through the use of medical examinations and diagnostic laboratory testing, to provide medical care for occupational injury or illness, to keep accurate records for future reference, and to ensure the selection of personnel physically able to safely perform the work assigned. The medical surveillance program supports and monitors the effectiveness of the primary health and safety goal of controlling worker exposure to hazardous substances. Medical examinations will be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine.

In general, Ramboll site-employees are Ramboll personnel who work in the field and may be exposed to hazardous substances. Ramboll's requirement is for site employees to be subject to a Medical Surveillance Program (non-site employees who wear respirators may also be subject to a medical surveillance program). Each employee enrolled in the Medical Surveillance Program will be subject to periodic medical exams, the frequency of which will vary depending on the extent and duration of exposure, the type of chemicals involved, and the individual employee's medical profile. These personnel will receive a medical examination at least once per calendar year.

Documentation of current participation in a medical surveillance program and fitness for duty, including ability to wear respiratory protective equipment, is available for all personnel who will work on-site in areas of active field work. However, all specific medical information and examination results obtained in the course of administration of the medical surveillance program is maintained by the examining physician as confidential.

6.1 Baseline Medical Examinations

The baseline medical examination serves two major purposes (1) it determines the individual's fitness for duty, including the ability to work while wearing a respirator; and (2) it provides baseline data for comparison with future medical data. The baseline medical examination includes, at a minimum, the following:

1. Complete occupational and medical history;
2. Physical examination;
3. Blood count and chemistry profile;
4. Urinalysis with microscopic review;
5. Chest x-ray;
6. Pulmonary function tests;
7. Resting electrocardiogram (EKG); and
8. Cardiac stress test (at physician's discretion).

Personnel who will be working in areas of active field work have a certification of fitness for duty and ability to wear personal protective equipment. However, all specific medical information obtained in the course of administration of the medical surveillance program is maintained as confidential.

6.2 Periodic Medical Examinations

Each individual enrolled in the medical surveillance program is subject to periodic medical surveillance examinations. In general, personnel involved in field activities with a frequency of greater than 30 days per year receive medical examinations at least annually. Periodic medical examinations include the

parameters included in the baseline examination, with the exception of the chest x-ray and EKG, which are repeated after the baseline examination at the physician's discretion and with agreement of the individual.

6.3 Special Medical Examinations

Special medical examinations or consultations will be arranged for personnel exposed in an emergency situation to hazardous substances at concentrations above the permissible exposure limits (PELs) without adequate protection. This will be done as soon as possible after the overexposure has occurred as determined by the Site Supervisor, in consultation with the CHSSD.

Special medical examinations shall also be arranged upon notification by the individual that he/she has developed signs or symptoms indicating a possible overexposure to hazardous substances, or if the examining physician determines that a more frequent medical examination is necessary.

In addition, Rio Tinto's Guidance Note, Health and medical monitoring programmes, dated September 2015, includes the *Health and medical monitoring* Group procedure that requires that health and medical monitoring programmes (also known as health and medical surveillance programmes) must incorporate planned medical services at defined intervals, including:

- prior to commencement of employment (pre-employment medical);
- change in role or location (pre-placement / transfer / pre-assignment medical);
- periodically during employment (periodic medical); and
- termination of employment (exit medical)."

Pre-employment, pre-placement, periodic, etc standards for medical examination should be appropriate to the actual or foreseeable future risks from the job position being offered or worked. Further, all contracts should be assessed for both possible health risks to the contractors from their or site operations and if a contractor's pre-existing poor health could cause risks to that employee or others.

6.4 Special Circumstances

Any individual who is on a medication that may interfere with the ability to perform his/her job function, or who may require special medical attention, must notify the Site Supervisor of these circumstances prior to commencing work at the Site.

6.5 Health and Safety Records

Health and safety records for on-site Ramboll personnel including but not limited to training, medical clearances, fit testing, and any monitoring are kept on file by the CHSSD and on-site by the Site Supervisor, as necessary. Subcontractor health and safety records shall be maintained by the applicable subcontractor and provided to the Site Supervisor, if requested. Ramboll Personnel Training and Medical Records are maintained at Ramboll, 333 West Wacker Drive, Chicago, Illinois.

7. PERSONAL PROTECTIVE EQUIPMENT

This section of the site-specific HASP is a reference for selection of different levels of PPE. The PPE will be selected based on the contaminant type(s), concentration(s) in air (if any), standing liquid (if any), or other applicable matrix, and the known route(s) of entry into the human body. In situations where the type of materials, their concentrations, or exposure potentials are unknown, a decision based on professional judgment regarding the use of PPE will be made by the HSSC.

7.1 Selection of PPE

The selected PPE should be able to resist degradation, penetration, and permeation by the contaminants present at the site. In selecting the appropriate protective material, the following should be considered: chemical resistance; tear and puncture resistance; flexibility; thermal stress; cleanability; and durability.

PPE will be selected, used and maintained in accordance with applicable regulations.

Levels of PPE

The four levels of PPE are Levels A, B, C, and D, with Level A providing the highest available level of respiratory, skin, and eye protection. A summary of the basic PPE ensemble for Levels A, B, C, and D is provided below. PPE selection for operations at the site will be tailored to address specific task conditions.

Level A

Level A PPE provides the maximum degree of respiratory, skin, and eye protection. A Level A PPE ensemble should include:

- Full-face piece self-contained breathing apparatus (SCBA) or full-face piece supplied air respirator with escape SCBA;
- Fully encapsulating, chemical-resistant suit, safety boots and inner gloves; and
- Hard hat (if overhead or bump hazards exist).

Level B

Level B PPE provides the maximum level of respiratory protection. Since chemical-resistant clothing is not considered gas, vapor, or particulate tight, Level B PPE does not provide the maximum skin protection. However, a good quality, hooded, chemical-resistant one-piece garment with taped wrists and ankles provides a reasonable degree of protection against splashes of liquids and lower concentrations of chemicals in ambient air. It is the minimum level recommended for confined space entries and initial site entries until the hazards have been further identified. Level B PPE should be used when any one of the following criteria is met:

- The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection but less skin protection – this includes atmospheres with Immediately Dangerous to Life and Health (IDLH) concentrations of specific substances that do not represent a severe skin hazard or atmospheres that do not meet the criteria for use of air-purifying respirators;
- Atmosphere contains less than 19.5% oxygen; or
- Presence of incompletely identified vapors or gases is indicated by air monitoring instruments but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.

Level C

Level C PPE provides the same level of skin protection as Level B PPE, but a lower level of respiratory protection. Air-purifying respirators can be used only if the substance has adequate warning properties; the individual passes a qualitative fit-test for the mask; an appropriate cartridge/canister is used and its service limit concentration is not exceeded; and site operations are not likely to generate unknown compounds or excessive concentrations of already identified substances. Level C PPE can be used when all of the following conditions are met:

- Oxygen concentrations are not less than 19.5%;
- Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin;
- Types of air contaminants have been identified, concentrations measured, and a cartridge or canister is available that can remove the contaminant;
- Atmospheric contaminant concentrations do not exceed IDLH levels; and
- Job functions do not require SCBAs.

Modified Level D

Modified Level D PPE provides minimal skin protection (i.e., hand/glove protection along with standard work clothes with optional coveralls) and no respiratory protection. Modified Level D PPE can be used when the following conditions are met:

- Atmosphere contains no known hazard;
- Oxygen concentrations are not less than 19.5%;
- Work functions include minimal contact with contaminated soil, water, groundwater and precludes splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Level D

Level D PPE provides no skin protection other than standard work clothes and no respiratory protection. Work functions are limited non-hazardous environments and preclude contact with media that may be potentially contaminated at hazardous levels for any type of chemical.

7.2 Respirator Fit Test

A respirator fit test has been conducted on all site personnel who will perform work operations in areas requiring the use of a respirator. Prior to the initiation of any fit testing, personnel were certified as medically able to wear a respirator. The respirator fit test was conducted to ensure proper face piece-to-face seal. A secure fit is important with positive-pressure equipment and is essential to the safe functioning of negative-pressure equipment, such as most air-purifying respirators. Personnel have received instruction on proper wear and maintenance of their respirator.

Qualitative fit tests are conducted annually in accordance with the ANSI Practices for Respiratory Protection, Z88.2-1989. In addition, a negative and positive fit check will be performed each time an employee dons the air-purifying respirator (APR). Documentation of annual respirator fit tests is kept on file by the CHSSD.

7.2.1 Negative and Positive Fit Check

A negative and positive pressure fit check will be performed each time an employee dons the APR. The negative pressure fit check involves closing off the inlet openings to the APR cartridges by covering with the palms of the hands and sucking in. If an inward leakage of air is detected, the APR should be checked for material defects and refitted or replaced with another APR.

The positive pressure fit check is performed by placing the palm of hand over the exhalation valve and gently exhaling for 10 seconds to create positive pressure inside the face piece. If an outward air leak is detected, the APR should be readjusted. If after readjustment leakage still occurs, another APR should be used.

7.3 PPE Inspection Checklist and Maintenance

PPE inspections will be conducted upon receipt of PPE from the factory or distributor; when it is issued to workers; after use or training; and prior to maintenance. Periodic inspections of stored equipment will be conducted routinely, whenever a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise. At a minimum, PPE inspections will include the following:

A. Clothing

Before use:

1. Determine that the clothing material is correct for the specified task.
2. Visually inspect for:
   - Imperfect seams,
   - Uniform coatings,
   - Tears, and
   - Malfunctioning Closures.
3. Hold up to light and check for pinholes.
4. Flex product:
   - Observe for cracks and
   - Observe for other signs of shelf deterioration.
5. If the product has been used previously, inspect inside and out for signs of chemical breakthrough or deterioration, such as:
   - Discoloration,
   - Swelling, or
   - Stiffness.
6. During the work task, periodically inspect for:
   - Evidence of chemical attack such as discoloration, swelling, stiffening, and softening (Keep in mind that chemical permeation can occur without any visible effects);
   - Closure failure;
   - Tears;
   - Punctures; and
   - Seam discontinuities.

B. Gloves

Before use, pressurize glove to check for pinholes. Either blow into glove, then roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.

C. Respirators

SCBA/supplied air/air-purifying:

1. Inspect SCBA/supplied air/air-purifying respirators before and after each use, at least monthly when in storage, and during cleaning. Air-purifying respirators should be inspected before each use to be sure they have been adequately cleaned.
2. Check all connections for tightness, inspect air lines prior to each use for cracks, kinks, cuts, frays, and weak areas.
3. Check for proper setting and operation of regulators and valves (according to manufacturer's recommendations) and check operation of alarms.
4. Check material conditions for:
   - Signs of pliability,
   - Signs of deterioration, and
   - Signs of distortion.
5. Check face shields and lenses for:
   - Cracks,
   - Crazing (network of fine, surficial cracks that can be seen but not felt), or
   - Fogginess.
6. Examine cartridges or canisters to ensure that:
   - They are the proper type for the intended use,
   - The expiration date has not passed, and
   - They have not been opened or used previously.

7.4 Task Specific PPE

This section of the site-specific HASP outlies the selection of the appropriate PPE. The PPE has been selected based on the contaminant type(s), concentration(s) in air (if any), standing liquid (if any), or other applicable matrix (e.g., soil, sludge, sediment, etc.) and the known route(s) of entry into the human body. Table 9 presents the general level of protection to be used for each task that is anticipated to be conducted on this Project.

Table 10 identifies the specific PPE items that are required or recommended to be used on this project. This includes identifying the specific type of hand and body protection (as applicable) for the chemicals that may be encounter while conducting the tasks outlined in this HASP.

Table 9: Task Specific PPE

Task Description as depicted in Section 1.4	Level of Protection					
	A	B	C	Mod D	D	NA
Task 1: Transportation	☐	☐	☐	☐	☐	☒
Task 2: Site Maintenance and Security	☐	☐	☐	☐	☒	☐
Task 3: Periodic Site Inspections	☐	☐	☐	☐	☒	☐
Task 4: SVE OM&M (existing system)	☐	☐	☐	☒	☐	☐
Task 5: Subsurface and Overhead Clearance	☐	☐	☐	☒	☐	☐
Task 6: Oversight of Subsurface Drilling	☐	☐	☐	☒	☐	☐
Task 7: Investigative-Derived Waste Management	☐	☐	☐	☒	☐	☐
Task 8: Oversight of Construction/Installation of Vapor and Liquid Treatment Systems	☐	☐	☐	☒	☐	☐
Task 9: Oversight of Installation of Heater Wells/VEWs and associated Instrumentation, Wiring, and Electrical Supply	☐	☐	☐	☒	☐	☐
Task 10: Oversight of ISTR Commissioning and Startup	☐	☐	☐	☒	☐	☐
Task 11: Vapor Sampling and Confirmation Soil Sampling including hot soil sampling. See note below.	☐	☐	☐	☒	☐	☐

Key:

Level D: Long sleeve shirt*; long pants*; hard hat; eye protection; hearing protection; and safety shoes.

Level D Modified: Level D protection plus protective coveralls, as required; and appropriate hand protection.

Level C: Level D (Modified) protection plus negative pressure respiratory protection with appropriate cartridges; chemical protective coveralls in lieu of general coveralls; use of inner and outer sets of hand protection.

Level B: Level C protection plus Pressure-demand supplied air respirator with escape bottle in lieu of negative pressure respirator; chemical resistant coveralls with hood; chemical resistant boots.

Level A: Level B protection plus fully encapsulating (gas tight) chemically resistant suit.
*Clothing made of natural fibers shall be worn when a shock or arc flash hazard exists.

Task 11 involves elevated temperatures. Work gloves will be worn and a thermometer will be used to ensure materials are at a safe temperature before they are handled.

Table 10: Personal Protective Equipment and Supplies

Equipment	Req	Rec	NA	Equipment	Req	Rec	NA
Steel-toe Boots	☒	☐	☐	SCBA	☐	☐	☒
Outer Disposable Boots	☐	☐	☒	Full-face Airline Resp.	☐	☐	☒
Long Sleeve Shirt and Pants	☒	☐	☐	Full Face Negative Pressure Resp.	☐	☐	☒
Flame Retardant Coveralls	☐	☐	☒	Half Face Negative Pressure Resp	☐	☐	☒
Tyvek Suit	☐	☐	☒	Powered Air Purifying Resp	☐	☐	☒
Poly-coated Tyvek / Saranex Suit	☐	☐	☒	First Aid Kit	☒	☐	☐
Fully Encapsulated Chemical Suit	☐	☐	☒	Fire Extinguisher	☒	☐	☐
Hearing Protection	☒	☐	☐	Mobile Phones	☒	☐	☐
Leather Gloves	☐	☒	☐	Walkie Talkies	☐	☒	☐
Outer Chemical Gloves (Type): Nitrile	☒	☐	☐	Water or Other Fluid Replenishment	☒	☐	☐
Thermal Insulating Gloves (if handling hot soil samples)	☒	☐	☐	Eye Wash	☒	☐	☐
Hard Hat	☒	☐	☐	Sunscreen	☐	☒	☐
Safety Glasses with Side Shields	☒	☐	☐	Insect Repellent	☐	☐	☒
Vented (Splash proof) Goggles	☐	☐	☒	Other: High-Visibility Vest/Long-Sleeve Shirt	☒	☐	☐
Face Shield, required when potential for exposure to steam from subsurface	☒	☐	☐	Other: Hair bonnet and beard net	☒	☐	☐

Key:
Req = Required;
Rec = Recommended;
NA = Not Applicable

8. AIR MONITORING/SAMPLING PROCEDURES

Air monitoring and air samples may be conducted and/or collected during the project to identify and/or quantify airborne contaminants in order to delineate areas where PPE, or additional PPE, may be needed; determine the level of PPE necessary; document on-site employees' exposures; assess the potential health effects of exposure; determine the need to implement engineering controls or evacuate the work zone or site; and determine the need for specific medical monitoring. Some commonly used devices include the following:

Combustible Gas Indicator (CGI) – An example of a CGI is a O2 / LEL meter. A CGI measures the concentration of a combustible gas or vapor. The limitations of a CGI include the following:

- Its accuracy is, in part, dependent upon on the difference between the calibration and sampling temperatures.
- Oxygen-deficient atmospheres affect accuracy.
- The filament can be damaged by silicones, halides, and tetraethyl lead.
- Its sensitivity is a function of the difference in the chemical and physical properties between the calibration gas and the unknown.

Flame Ionization Detector (FID) – An example of a FID is an Organic Vapor Analyzer (OVA). Depending on mode, a FID may detect many organic gases and vapors. The limitations of a FID include the following:

- It will not detect inorganic gases and vapors.
- It has reduced reliability in high humidity conditions.
- It should not be used when temperatures are below 40ºF (4.4ºC).

Ultraviolet (UV) Photo Ionization Detector (PID) – An example of a PID is a HNu. A PID detects a number of organic and some inorganic gases and vapors. Based on the PID device, volatile organic compounds are measured in parts-per-million (ppm) or parts-per-billion (ppb). The limitations of a PID include the following:

- It does not detect methane.
- It does not detect a compound if the probe used has a lower energy than the compound's ionization potential.
- It does not readily ionize fully chlorinated materials.
- High and low humidity affect its operation.
- Its response is sensitive to dust or moisture on the lamp.
- Responses will fluctuate when gases are mixed.

Infrared Spectrophotometer (IR) – An example of an IR is a Miran. This instrument measures concentrations of many gases and vapors in the air but is designed to quantify one- or two- component mixtures. The limitations of an IR include:

- It is not approved for use in hazardous conditions.
- It must make repeated passes to achieve reliable results.

- It is somewhat bulky/heavy.

Multi-Gas Meter - An example of a multi-gas meter is a Rae MultiRAE. The MultiRAE can test for VOCs, combustibles, and a range of toxic threats, as well as monitor sufficient oxygen levels.

Direct-Read Colorimetric Tubes – An example of a colorimetric tube is a Draeger Tubes. In a colorimetric tube, the compound reacts with the indicator chemical in the tube, producing a stain whose length is proportional to the compound's concentration. Limitations of colorimetric tubes include:

- The results are affected by temperature, pressure, and humidity.
- Many similar compounds interfere with results.

Dust Monitoring - An example of a Dust Monitor is a TSI DustTrak™ Aerosol Monitor or TSI P-Trak Ultrafine Particle Counter to measure airborne concentration levels of welding related smoke and fume and diesel exhaust. The DustTrak Aerosol Monitor is a light-scattering, photometric aerosol mass concentration instrument that provides a precise, repeatable, real-time measurement of aerosol mass concentration based on light scattering properties of a known test aerosol. The P-Trak Ultrafine Particle Counter uses a focused laser light source and photodetector to detect and count ultrafine particles (< 0.1 Micron diameter). Welding and diesel exhaust generates ultrafine particles of smoke and fume, including compounds like manganese and hexavalent chromium, which if not properly controlled can be inhaled by workers. The DustTrak and P-Trak can be used to monitor the effectiveness of the ventilation controls in real time.

Personal or Area Air Monitoring – An example of personal, or area, air monitoring is quantitative air sampling for nuisance dust, metals, organic compounds, and/or inorganic compounds. Samples are collected using personal air sampling pumps and the appropriate sampling media. Personnel samples are collected in the employees' breathing zones over the duration of the work shift. Area samples are collected in areas that may represent the worst-case scenario for expected exposures. The specific methods used for the collection of personal air samples will require the involvement of a Certified Industrial Hygienist (CIH) if this type of sampling is conducted.

Using Monitoring Devices

Conducting an applicable task may necessitate using one or more monitoring devices as listed in Table 11, particularly if gases, vapors, explosion hazards, and/or oxygen deficient atmosphere are present or are expected. If a monitoring device will be utilized, the corresponding device letter has been placed in the column labeled "Monitoring Instrument Required" in Table 12. In addition, the following information will be recorded in the field log book when using a monitoring device:

1. Instrument name and serial number,
2. Date of calibration,
3. Frequency/duration of monitoring,
4. The monitoring results, and
5. The actions taken based on the results, even if no actions are required to be taken.

Table 11: Monitoring Devices Available

A	PID (10.6 eV)		H	Summa Canister
B	PID (11.7 eV)		I	Heat Stress Monitor
C	FID		J	Air Sampling: personal and area air monitoring (pumps with sampling media, passive badges)
D	OVA		K	Air Sampling:
E	CGI/LEL		L	Radiation Detector
F	Colorimetric Indicator Tubes		M	Gas Multimeter
G	Dust Monitoring (DustTrak, P-Trak)		N	Other Device: Noise dosimeter, multi-gas meter

Table 12: Required Monitoring

If monitoring is necessary to identify that a risk is at or above tolerable limits and/or is used in controlling a risk on site, document the task and the maximum allowable exposure or trigger, and the monitoring instrument required to be used.	**Constituent**	**Task(s)**	**Trigger (action level [AL])**	**Monitoring instrument required**
	Oxygen	6, 9	<19.5% or >23.5%	M
	Hydrogen sulfide	6, 9	TLV 1 ppm STEL – 5 ppm	M
	Carbon dioxide	, 6, 8, 9	IAQ AL: 1000-1200 (700 ppm above outdoor [300-500 ppm]) PEL 5000 ppm	M
	Ozone	6, 8, 9	PEL 0.1 ppm	
	Carbon monoxide	6, 8, 9	PEL 50 ppm	M
	Combustible gas	6, 8, 9	10% LEL	M
	VOCs: TCE Toluene	4, 6, 8, 9, 10, 11	 AL: 5 ppm (sustained for 5-min) 12.5 ppm (for 15-min) TLV 10 ppm STEL 25 ppm PEL 200 ppm	A, F, J, M
		N/A		
	Metals: Arsenic Copper Hexavalent chromium Nickel	6, 8, 9	 PEL 0.5 mg/m^3 PEL 1 mg/m^3 PEL 5 ug/m^3 PEL 1 mg/m^3	G, J, M
	Dusts and fumes: Total dust Respirable dust Welding fumes Crystalline silica Nitric oxide Nitrogen dioxide Zinc oxide	6, 8, 9	 PEL 15 mg/m^3 PEL 5 mg/m^3 TLV 5 mg/m^3 PEL 50 µg/m^3 PEL 25 ppm PEL 5 ppm (ceiling) PEL 5 mg/m^3	G, J, M
	Other: Noise	6, 8, 9, 10, 11	AL: 82 dB TWA 85 dB (continuous noise)	N

			140 dB (impulse noise requires the use of dual hearing protection)	

Personal, and possibly area, quantitative air samples will be collected over the duration of several days of drilling, welding, concrete cutting, and grout mixing, as needed, to establish and evaluate employee full-shift TWA exposures to TCE, welding fumes (which may include arsenic, copper, nickel, ozone, and zinc oxide), hexavalent chromium, crystalline silica, and diesel exhaust (which may include carbon monoxide, nitric oxide, and nitrogen dioxide). Sampling will be conducted in accordance with applicable National Institute of Occupational Safety and Health (NIOSH) and Occupational Safety and Health Administration (OSHA) methods.

8.1 Action Level Guidance

In general, this HASP addresses site-specific chemicals with their respective monitoring action levels noted in Tables 12 and 14. However, there are chemicals commonly encountered in the workplace that may not be a chemical targeted for sampling but nonetheless will have adverse health effects. These chemicals are listed in Table 13.

Table 13. Action Levels for Commonly Encountered Compounds

Compound	Action Level
VOC (as Benzene)	0.5 ppm MAXIMUM
CH_4	0.5% MAXIMUM or 5000 ppm
CO_2	0.25% OR 2500 ppm MAXIMUM
CO	25 ppm MAXIMUM
H_2S	5 ppm MAXIMUM
O_2	19.5% MINIMUM – 23.5% MAXIMUM

8.1.1 Volatile Organic Compounds

Due to VOCs present from facility operations, additional monitoring will be conducted while activities are ongoing inside the Albéa facility, as described below.

The action levels listed in Table 14 are based on 50% of TLV-TWA (i.e., 5 ppm) and TLV-STEL (i.e., 12.5 ppm) for TCE (Table 5 shows TCE's TLV-TWA is 10 ppm and TLV-STEL is 25 ppm). If a sustained (as indicated in Table 14) total VOC reading within the breathing zone (BZ) by a PID is above the action level (AL) listed, site personnel shall attempt to mitigate the situation through the use of engineering controls (e.g., increase air circulation) or administrative controls (e.g., stand upwind) as indicated in Table 14. If the readings are still above the AL, colorimetric indicator tube (e.g., Draeger tubes) samples specific for TCE and toluene will be collected from the BZ. If colorimetric indicator tubes indicate that concentrations of TCE or toluene are above their respective ALs (i.e., 5 ppm for TCE and 10 ppm for toluene), personnel shall leave the area and contact the PM and HSSC for further instructions. If colorimetric indicator tubes indicate that TCE or toluene concentrations are below their respective ALs, then the PID AL will be revised. If TCE does not exceed its AL (5 ppm), but toluene exceeds its AL (10 ppm) then an AL of 10 ppm will be used. If neither TCE or toluene exceed their ALs, then an AL of 100 ppm will be used (e.g., half of the lowest exposure limit for the other known compounds that have been detected during past and recent air sampling events [isopropanol and ethyl acetate]). Colorimetric

indicator tube sampling for TCE and/or toluene will be conducted every 15 minutes while PID readings remain above 5 ppm.

Table 14: Volatile Organic Compounds

Instrument	Calibration Gas Standard	Frequency / Duration of Air Monitoring	Action Level (AL) Above Background in Breathing Zone	Action
Step 1: Monitor Worker Breathing Zone with PID				
PID - total VOCs	Calibrate at least once per day using 100 ppm isobutylene	1. 5-min data-logged avg (collect throughout duration of shift); and/or 2. 15-min data logged avg (at least once every 2 hrs)	IF: 1. >5 ppm (TLV AL) 2. >12.5 ppm (STEL AL)	Evaluate existing controls and introduce additional engineering and/or administrative controls.
Step 2: After Introduction of Engineering Controls, Again Monitor Working Breathing Zone with PID				
PID - total VOCs	Calibrate at least once per day using 100 ppm isobutylene	1. 5-min data-logged avg (collect throughout duration of shift); and/or 2. 15-min data logged avg (at least once every 2 hrs)	IF: 1. >5 ppm (TLV AL) or 2. >12.5 ppm (STEL AL)	Collect colorimetric indicator tubes samples for TCE and toluene.
Step 3: Collect Colorimetric indicator tube sample for TCE, if required by Step 2.				
Colorimetric indicator tubes – TCE only	N/A	Collect as required by Step 2.	If result is >5 ppm (TLV AL) If result is significantly <5 ppm for TCE and <10 ppm for toluene (TLV AL)	Leave area and contact PM and HSSC for further guidance. The PID AL will be revised to 100 ppm if TCE and toluene are not present above their respective AL (5 ppm and 10 ppm, respectively) (lowest TLV AL of isopropanol or ethyl acetate). Colorimetric indicator tube sampling for TCE will be conducted every 15 min while PID readings remain above 5 ppm.
Step 4: If the AL is revised to 10 ppm, collect routine colorimetric indicator tube samples for TCE and toluene.				
Colorimetric indicator tubes – TCE and toluene	N/A	Collect routinely, at a minimum every two hours during intrusive drilling activities.	If result is above or approaching 5 ppm for TCE If result is above 10 ppm for toluene	PID AL will be returned to the AL for TCE (5 ppm). Leave area and contact PM and HSSC for further guidance.
Step 4: If the AL is revised to 100 ppm, collect routine colorimetric indicator tube samples for TCE and toluene.				
Colorimetric indicator tubes – TCE and toluene	N/A	Collect routinely, at a minimum every two hrs during intrusive drilling activities.	If results are at or approaching 5 ppm for TCE or 10 ppm for toluene If result is <5 ppm for TCE and <10 ppm for toluene (TLV AL)	PID AL will be returned to the appropriate AL for TCE (5 ppm) or toluene (10 ppm). AL will depend on which constituent is detected. If both are detected at concentrations at or nearing their respective TLVs, then use the more restrictive TLV of 5 ppm for TCE. Continue using current AL.

8.1.2 Combustible Gas Indicator (CGI)/Oxygen Meter/Multi-Gas Meter

Diesel-powered equipment (e.g., drill rig, forklift) will be used during drilling operations. Equipment exhaust will be ventilated to the outside. Additionally, a multi-gas meter will be used to monitor the breathing zone adjacent to and surrounding the drilling operations to verify proper ventilation is maintained. The multi-gas meter will run continuously over the shift to monitor for oxygen, carbon monoxide, and the lower explosive limit.

In addition, the multi-gas meter will be used to monitor for hydrogen sulfide gas while the cooling tower for the treatment system is operating to assist in determining the effectiveness of housekeeping in minimizing sludge or residue build up in the cooling tower water.

Table 15: Combustible Gas Indicator (CGI)/Oxygen Meter

Meter Response	Action/Respiratory Protection
CGI response <10% LEL	Continue normal operations with regular, periodic monitoring
CGI response > 10% LEL	Discontinue operations; evacuate personnel and prohibit entry; allow to vent until readings are <10%.
Oxygen level <19.5% or >23.5%	Retreat from work area; consult with PM and HSSC about upgrading to Level B respiratory protection, adding mechanical ventilation, or possible changes in work practices.

8.1.3 Odors

If strong odors are encountered or if personnel develop headaches, dizziness or other potential exposure symptoms, the personnel shall move from the work area to a well-ventilated area and contact the PM and HSSC for further instructions.

Carbon dioxide, a byproduct of combustion as well as a result of the metabolic process in living organisms, can be used to indicate whether adequate fresh air is being supplied to an indoor space. The amount of fresh air that should be supplied to a room depends on the type of facility and room; however, ventilation should keep carbon dioxide concentrations below 1,000 ppm. Carbon dioxide will be monitored during work activities in the Molding Room to assist with determining the adequacy of ventilation.

8.1.4 Dusts

The permissible exposure levels for total and respirable dusts are 15 and 5 mg/m^3, respectively. In general, you will not be able to read the face of a wristwatch (with your arm extended) when the total dust concentration reaches 15 mg/m^3. Particles of dust in the respirable size range cannot be seen without the aid of a microscope but in aggregate, may be perceived as a haze. More importantly and with few exceptions, when dust is noticeable in the air, more respirable particles will exist than larger particles.

Typically, controlling dusty activities through the use of a water sprayer will control potential exposures. However, in the event that dusty conditions exist that are not related to investigative/remedial activities (e.g., dry, uncovered soils with high winds), personnel shall leave the area and contact the PM and HSSC for further instructions.

Nonetheless, to determine the likelihood of exposure from dusts, a theoretical “Total Dust” concentration in mg/m^3 can be calculated to estimate the total dust concentration in which the concentration of the

contaminant in the soil could equal and/or exceed its' established exposure limit (EL). This equation is as follows:

Total Dust (mg/m^3) = (10^6 mg/kg) (EL mg/m^3) / (Conc. of contaminant in soil mg/kg) (SF)

Where:

EL = Exposure Limit of the contaminant of concern (e.g., its PEL or TLV in mg/m^3) and

SF = Safety Factor, a number between one and ten. Used to account for the degree of confidence in the characterization data (a ten would represent a poor degree of confidence, for example only one soil sample was collected / analyzed to characterize the site).

The **SF** is based upon the following assumptions: 1) the concentration of the contaminant in the airborne dust is the same as its' concentration in the sample matrix; 2) the soil data represents "worst-case" scenario; 3) the monitoring instrument accurately measures the ambient concentration of particulate matter in the air; and 4) a single contaminant of concern is present.

As an example, assume that lead (with an EL of 0.05 mg/m^3) is the contaminant of concern and a soil concentration of 25,000 mg/kg has been identified. Depending on the SF used, the theoretical total dust concentration will range between 2 and 0.2 mg/m^3. This means that when the in-situ particulate monitoring device is registering a concentration within the 2 to 0.2 mg/m^3 range, there is a high probability that this dust contains enough lead to equal and/or exceed the EL. Hence, the level of PPE used would be increased until engineering controls are determined to be effective as documented by personal monitoring.

In addition, real time monitoring for dust and ultrafine particles will be conducted to monitor for diesel particulates (e.g., components such as nitric oxide and nitrogen dioxide) and welding fumes (including components such as hexavalent chromium, arsenic, copper, nickel, zinc oxide, and ozone) during indoor activities and for crystalline silica during grout mixing and concrete cutting to ensure proper ventilation and exhaust is maintained. The ACGIH TLV for welding fumes is 5 mg/m^3, the OSHA PEL for hexavalent chromium is 5ug/m^3, the PELs for arsenic, copper, nickel, and zinc oxide are 0.5 mg/m^3, 1 mg/m^3, 1 mg/m^3, and 5 mg/m^3, respectively. The AL and PEL for crystalline silica are 25 $\mu g/m^3$ and 50 $\mu g/m^3$, respectively, and the PELs for nitric oxide and nitrogen dioxide are 25 ppm and 5 ppm (ceiling), respectively. Ultrafine particles indoors are expected to be similar to outdoors in the absence of emission producing sources such as internal combustion engines, metal fumes from welding, and electric motors.

In general, dust and particle emissions will be controlled using engineering controls, e.g., water, ventilation, staying upwind. When real-time monitoring results indicate that total or respirable dust are above their respective exposure limits (15 and 5 mg/m^3) or ultrafine particles are above background outdoor and/or indoor levels then engineering controls will be evaluated and adjusted. If engineering controls cannot be adjusted then administrative controls, such as limiting time workers spend performing dust generating activities, will be implemented. PPE, e.g., half-face or full-face respirators will be worn if engineering controls and administrative controls do not adequately control dust levels.

8.2 Noise

Hearing protection should be worn by all personnel when working within 25 feet of operating heavy equipment (drilling rigs, earth working equipment, etc.), where noise is sufficient to interfere with general conversation at a normal speaking volume, when continuous noise levels exceed 85 A-weighted decibels (dBA), impulse noise levels exceeds 140 dB, and/or when the manufacturers' requirements indicate that hearing protection is mandatory.

HPDs (hearing protective devices) may be used to reduce the amount of noise exposure while control measures are being evaluated or if controls fail to reduce the exposure levels to below 85 dBA. The use of HPDs are mandatory when 8-hour TWA noise exposure exceeds 85 dBA. In addition, dual hearing protectors are required whenever impulse noise levels exceed 140 dB.

Noise dosimeters will be used to continuously monitor noise levels during work activities to provide real-time personal noise exposure readings and to determine the level of hearing protection that is required.

9. CONFINED SPACE ENTRY

Ramboll's health and safety policy prohibits unauthorized entry into confined spaces. In the event that entry into a confined space is required, Ramboll employees (or its subcontractor's employees) will need additional training prior to entering the confined space. Without supplemental Confined Space training, entry into confined spaces is prohibited. In addition, entry authorization will only be given after Ramboll management has reviewed the nature of the confined space, the hazards present, and the measures needed to ensure safety. Under these circumstances, Ramboll will work with the host facility/client to determine training requirements, sampling requirements, written program requirements, and equipment needed to safely enter the confined space.

Though confined spaces will be present on the site, no confined space entry will be required for Ramboll personnel on this project. If confined space entry is required, management approval will be required and this HASP will be modified accordingly to adhere to all applicable regulations.

10. SPILL RESPONSE

If warranted, applicable local, state, and/or Federal Emergency Response Authorities will be identified and contacted by either the Client Contact and/or a designated Ramboll employee before any spill clean-up work is initiated at the site.

10.1 Reporting and Initial Personnel Safety

Upon discovery of a hazardous substance spill, personnel are to:

- Immediately summon help by notifying the PM and the Client Contact;
- Take action to ensure the safety of nearby personnel;
- Proceed to a safe location;
- If anyone is seriously injured, immediately contact emergency medical services; and
- Keep unauthorized personnel out of the area.

10.2 Initial Spill Reaction

Factors that limit the employee's response at the site of a spill are:

- Level of training,
- Personal safety,
- Available PPE, and
- Knowledge of the substance.

Employees should limit their actions to shutting off equipment or pumps and closing valves if possible, feasible, and safe to do so.

10.3 Spill Response Evaluation

The identity and hazards of the spilled material should be determined before decisions regarding spill containment and control are made. The Client contact and PM should evaluate the hazards regarding the spill and decide whether project employees or external response organizations should conduct the cleanup.

The PM must contact the PIC and CHSSD to discuss the spill incident for further input on deciding how the cleanup can be conducted, including:

- Levels of PPE and safety procedures,
- Safety and work zones,
- All steps of the response activities,
- Most effective procedures or methods for cleanup,
- Means of containment,
- Leak and spill control, and
- Decontamination procedures (including Emergency decontamination)

11. DECONTAMINATION

11.1 Sampling and Construction Equipment Decontamination

Decontamination involves the orderly controlled removal of contaminants. All undedicated sampling equipment and sampling meters (if applicable) will be cleaned prior to use and between each location. All on-site equipment will be decontaminated and allowed to air dry before leaving the site. Decontamination may be accomplished using an approved cleaner, water, and/or steam. Subcontractors will be responsible for decontamination of their own equipment used during field operations, as well as disposal of the decontamination fluids. Decontamination fluids and soil cuttings will be temporarily stored in sealed and labeled 55-gallon drums, staged at a safe location which is mutually acceptable to Ramboll and the host facility, pending offsite disposal.

11.2 Personnel Decontamination

All site personnel should minimize contact with contaminants. At a minimum, the gross removal of contaminants from PPE shall occur in a designated area. All disposable PPE will be disposed of in approved 55-gallon drums (including respirator cartridges). Non-disposable PPE, particularly safety boots, will be decontaminated. Any PPE that cannot be decontaminated should be disposed of along with the waste generated from field operations. The drums will be sealed and labeled appropriately, stored at a single secure location on the site, and be disposed of appropriately off-site. Personnel should wash their hands and face prior to departing from the site and prior to eating, drinking, smoking, and/or applying cosmetics. The decontamination methods will be as follows:

Modified Level D Personnel Decontamination

Where activities are performed in Modified Level D PPE personnel will perform decontamination using the following guidelines:

- Personnel will place tools, instruments, samples and trash in an appropriate location. The equipment drop area should be clean and dry, and, at a minimum, plastic bags should be available for trash. Waste PPE will not be placed in the same containers as general trash.
- Personnel will inspect equipment, samples, and if applicable, tools for signs of residual amounts of contamination or excessive soil buildup. If present, soils and contamination must be completely cleaned off of equipment, samples, and tools prior to removal from the decontamination areas.
- Personnel will visually check themselves for signs of excessive soils and possible contamination. If observed, soils and contamination will be completely removed before further decontamination is performed.
- Personnel will remove outer work gloves, if used, and place them in an appropriate container designated for waste PPE.
- Personnel will remove outer Tyvek coveralls, if used, and place them in an appropriate container designated for waste PPE.
- Personnel will remove inner protective gloves and place them in an appropriate container designated for waste PPE.
- Personnel will wash hands using soap and water (separate from other decontamination cleaners/solutions).

Level C Personnel Decontamination

Personnel involved in activities that require the use of Level C PPE will observe the following decontamination guidelines:

- Personnel will place tools, instruments, samples, and trash in an appropriate location. The area should be clean and dry, and, at a minimum, contain plastic bags for trash. Waste PPE will not be placed in the same containers as general trash.
- Personnel will inspect equipment, samples, and, if applicable, tools for signs of residual amounts of contamination or excessive soil buildup. If present, soils and contamination must be completely cleaned off of equipment, samples, and tools prior to removal from the decontamination areas. Personnel will visually check themselves for signs of excessive soils and possible contamination. If observed, soils and contamination will be completely removed before further decontamination is performed.
- Personnel will untape wrists and ankles.
- Personnel will remove outer work gloves and place them in an appropriate container designated for waste PPE.
- Personnel will remove outer Tyvek coveralls and place them in an appropriate container designated for waste PPE.
- Personnel will wipe off and remove respirator mask (also goggles if worn).
- Personnel will remove inner protective gloves and place them in an appropriate container designated for waste PPE.
- Personnel will wash hands using soap and water (separate from other decontamination cleaners/solutions).

During emergencies, the need to quickly respond to an accident or injury must be weighed against the risk to the injured party from chemical exposure. It may be that the time lost decontaminating an individual may cause greater harm to the individual than from the potential for chemical exposure, particularly if the injury is life-threatening. In these instances, a non-injured person needs to inform responding emergency personnel of the potential for chemical contamination on the victim, specifically mentioning the type and expected concentrations.

11.3 Investigation-Derived Waste Disposal

Wastes generated from the operation of the Soil Vapor Extraction System (vapor intrusion) and ISTR vapor/liquid treatment systems include the following:

- Spent carbon: Vacuumed out of unit, containerized, and staged on-site until transported to a carbon recycling facility for reactivation, then returned to system
- Condensate: Removed by pumping/draining condensate storage tank to approved 55-gallon drums. The drums will be sealed and labeled appropriately, stored at a single secure location on the site, and be disposed of at the GWETS.

The general trash produced as a result of OU3 activities does not require approval for off-site disposal and will be removed from the site and disposed in a trash receptacle. Waste lubricating and motor oils will be collected in waste oil containers (size may vary based on anticipated volume of material) and will be removed by the contractor conducting the maintenance activities for off-site disposal after each maintenance event. The management of the other wastes generated at the Site will require off-site approval prior to disposal. Information regarding the off-site transfer and disposal of wastes, waste

characterization frequency and parameters, and notification to USEPA Region 2 to obtain verification that the off-site disposal facility is USEPA-approved to receive the waste can be found in the OU3 Waste Management Plan.

Investigation-derived solid wastes (e.g., drill cuttings, decontamination solutions, or disposable tools and PPE) will be handled appropriately and will be temporarily stored in covered roll-off boxes on site or in sealed and labeled 55-gallon drums and staged at a safe location pending offsite disposal. Drums will be stored on pallets. ISTR condensate water will be temporarily stored in an on-site frac tank then periodically transported to the GWETS for introduction into the treatment system via the building sump.

12. EMERGENCY RESPONSE PLAN (ERP) GUIDELINES

For this site, Ramboll has prepared a separate stand-alone ERP (if you have not reviewed the site-specific ERP, please follow-up with the Project Manager). For the purposes of this HASP, this section provides guidelines for the ERP. The ERP describes contingencies and emergency response procedures; defines the responsibilities of key personnel in planning, prevention, and response to emergency situations; identifies agency contacts; specifies medical care procedures; and specifies measures to prevent and respond to emergency situations such as fire or explosion, spill or release of hazardous material, personnel injury or illness, or other adverse events. General emergency guidelines are summarized in the following subsections.

12.1 Stop Work Authority

All Ramboll employees have the authority and obligation to stop any task or operation where concerns and/or questions regarding the control of HSE risk exist, are not clearly established, or are not understood. Management is responsible for creating a culture where Stop Work Authority is exercised freely and without fear of retribution or intimidation.

When an unsafe condition is identified, a Stop Work intervention will be initiated and treated as a "near miss." As such, an incident report will be completed in accordance with Ramboll's Standard Practice Instruction 19 entitled "Incident Reporting" so that the unsafe condition can be documented and reviewed, and corrective actions and preventative measures can be implemented as applicable.

These actions will be coordinated by the Site Supervisor, with support from the PM or PIC and the HSSC, and all affected personnel will be notified of the Stop Work issue. No work will resume until all Stop Work issues and concerns have been adequately addressed. Most issues can be resolved in a timely manner at the job site, but occasionally additional investigation and corrective actions may be required. Work may resume when it is safe to do so.

12.2 Personnel Involved in Emergency Response

Key personnel involved in site emergency response include the PM, Site Supervisor, the PIC and contractor project managers. Clear lines of authority have been established within this HASP for implementing emergency response procedures and for ensuring safety compliance. All emergencies and personal injuries will be immediately reported to Site Supervisor. The Site Supervisor will immediately report the incident to the PIC/PM and CHSSD.

12.3 Emergency Response Telephone Roster

The Emergency Response Telephone Roster consists of persons and organizations both on- and off-site who would be involved in the emergency response. This roster, provided as Table 1A, will be kept in the Ramboll site vehicle. A list of on-site personnel who are trained in first aid and CPR will also be kept in the on-site file. Site personnel will be familiar with the Emergency Response Telephone Roster and will understand the proper chain of command. A listing of on- and off-site emergency contacts and key personnel and their alternates will be posted in the site office or kept in the Ramboll site vehicle.

12.4 Emergency Communications

The external communication system between on-site and off-site emergency response personnel is necessary to report and coordinate emergency response. Personal cell phones will be the primary means of external communication and will be used to notify off-site emergency response agencies and to request assistance.

12.5 Emergency Medical Care and Treatment

Every injury and exposure will be reported according to the procedures outlined in section 5.7 of this HASP, regardless of whether the incident appears to be serious or not, or whether any adverse health effects or symptoms are apparent after the exposure. Universal precautions to bloodborn pathogens shall be observed while administering first aid.

12.6 Life-Threatening Emergency Response

Incidents are possible that would result in emergencies beyond the on-site emergency response capabilities. Such incidents might include:

- Life-threatening injuries,
- Injuries/exposures requiring medical treatment, and
- Fires progressing beyond incipient stage.

12.7 Evacuation Routes and Procedures (Rally Point)

During site operations and in the event of an evacuation, a safe location (Rally Point) will be identified. As part of the site orientation, all on-site personnel will be informed of the evacuation plan and Rally Points. For purposes of a safe and efficient means of vehicular egress, all vehicles will be backed into their designated parking location.

If evacuation is necessary, personnel will determine wind direction. Whenever possible, evacuation should be in the direction perpendicular to the wind direction without passing through a plume, smoke cloud, and/or spilled material, if applicable. Personnel will report to their designated Rally Point. In the event that a worker's evacuation to their primary Rally Point is hindered by emergency conditions, workers shall evacuate to the secondary Rally Point. If the on-site PM is not involved in emergency response activities, he/she will assist in accounting for all Site personnel, otherwise their designated back-up will account for all personnel and will report this information to the Site Supervisor.

For the remedy construction activities, the Rally Point is located at the entrance to the Albéa site from New Jersey State Highway 31. A secondary rally point for workers on the Vikon Tile property is located at the Taylor Street entrance gate. For MNA Well Installation activities the offsite Rally Point is the entrance to each fenced-off drilling area.

12.8 Training

All site personnel will review the information in this HASP on the emergency response procedures and the location and use of on-site emergency equipment and will have received emergency response training. During the site orientation and/or site safety briefings, Site personnel will be trained in emergency response procedures, on-site communication systems, and evacuation routes, as stated in this HASP. Visitors will be briefed on hazard recognition, safe work practices and basic emergency procedures by the Site Supervisor.

12.9 First Aid Procedures

If an employee is injured, general first aid will be administered. If safety concerns or hazardous conditions are still present (e.g., incipient fire, falling debris), the individual shall be moved to avoid further injury or risk. In the event that an employee is injured in a contaminated area, general first aid will be administered and then the employee will be moved to an uncontaminated area for decontamination (if applicable), additional first aid, and preparation for transportation, giving due consideration to which risk will be greater; the spread of contamination or the health/safety of the individual.

First aid kits will be maintained on site at each project location. The type of first aid kit to be maintained will be for minor emergencies, such as cuts and skin abrasions. Where applicable, first aid supplies will be stored in a water proof container. The Site Supervisor or designated person will ensure that adequate first aid supplies (listed below) are maintained.

Minimum List of First Aid Supplies

(1) First Aid Guide*	(6) Burn treatment applications
(1) Absorbent Compress >4"x8"	(4) 3"x3" Sterile gauze pads
(16) 1"x3" Adhesive bandages	(2) Pair medical exam gloves
(1) Adhesive tape 2.5-yard roll	(1) Triangular bandage >40"x40"x56"
(10) Antiseptic treatment applications	(6) Antibiotic ointment applications

*Please see Appendix D First Aid Guidance, print, and store with ANSI approved First Aid kit on-site.

Recommended List of First Aid Supplies

Analgesic (oral, non-drowsy)	Eye covering >1/4" thick
Bandage compress >2"x2"	Eye/face wash
Breathing barrier, single use	Roller bandage >2"x4yards
Cold pack >4"x5"	Hand sanitizer

The contents of the first aid kits will be checked before being sent out to each job and at least weekly on each job to ensure that expended items are replaced. Where the eyes or body of any employee may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be available for use.

12.10 Uncovering an Underground Service

In the event of any damage or dislocation of any underground facility/pipeline or utility in connection with ground disturbance activity, work activities shall cease in the area of the damaged facility. The Designated Person shall immediately call the applicable emergency phone number. Then, the affected utility and One Call service shall be notified, if applicable. The One Call service may be able to assist with contact numbers for notifying member companies in the event of any damage. NO ONE should attempt to repair, clamp or constrict the damaged utility.

ALWAYS ASSUME THAT ANY UNDERGROUND PIPE OR SUBSURFACE LINE IS LIVE!

The following procedures will be followed when an underground facility/pipeline or utility is damaged:

- Stop Work; remove tools if safe to do so.
- Clear all persons from the scene.
- Call the emergency number.
- Contact the One Call/utility member for guidance, if applicable.
- Contact the PM and/or PIC so they can contact the Client, Managing Principal (MP), CHSSD, and HSSC.

12.11 Striking an Underground Electrical/Telecom Cable

The following procedures will be followed when an underground electrical/telecom cable is struck:

- Stop work.
- Evacuate personnel from the immediate area to a safe distance as site conditions warrant, giving consideration to employees that may not be able to immediately evacuate (e.g., operator seats in excavators are normally electrically isolated, whereas other parts of the excavator may be energized).
- Call the emergency number.
- In the event of injuries provide first aid and summon medical assistance.
- Contact the One Call/utility member for guidance, if applicable.
- Contact the PM and/or PIC so they can contact the Client, MP, CHSSD, and HSSC.
- Do not allow anyone to enter the area until the utility provider has made the cable safe.

12.12 Striking a Pressurized Gas Pipeline

The following procedures will be followed when a pressurized gas pipeline is struck:

- Stop work, leave tools in-place but shut off any running equipment, including engines.
- Evacuate the immediate area to a safe distance as site conditions warrant.
- Ensure there are no sources of ignition in the area.
- Call the emergency number.
- Contact the pipeline owner and/or One Call, if applicable.
- Contact the PM and/or PIC so they can contact the Client, MP, CHSSD, and HSSC.
- Do not re-enter the immediate area until it is safe to do so.

12.13 Striking a Pressurized Water Main

The following procedures will be followed when a pressurized water main is struck:

- Stop work, remove tools and confine jetting water if safe, necessary, and appropriate to do so.
- Evacuate the immediate area.
- Ensure that water flowing away is not creating potential hazards (e.g., electrical shorting, flooding, contaminant migration, etc.) and where possible warn those likely to be affected.
- Call the emergency number.
- Contact the water utility and/or One Call, if applicable.
- Contact the PM and/or PIC so they can contact the Client, MP, CHSSD, and HSSC.
- Do not re-enter the immediate area until it is safe to do so.

12.14 Follow-Up Procedures

If a site employee is injured on site and immediate medical treatment beyond first aid is needed, the designated Site Supervisor will call 911 and/or the designated emergency phone number and then report the incident to the PM/PIC.

Any SSC work that results in an injury, illness, incident, near miss, or unsafe act or condition will be verbally communicated by the affected employee or a Ramboll employee witnessing the incident to either the local HSSC, PM, or PIC immediately following the incident. Notification to the regional HR representative, the Director of HR, and the CHSSD MUST also be made for incidents involving any employee injury and/or illness that happened while on company time including first aid and doctor/hospital visits which may or may not involve restricted work and/or lost time.

As soon as possible after the incident but no later than 72 hours after the event, the first page of the Incident Reporting Form in SPI 19, Incident Reporting, is to be completed by the employee and a witness that was involved in the incident and/or observed the incident (if applicable).

A post-incident investigation and root cause analysis will be conducted by the CHSSD to discover the exact circumstances and cause of the incident. Amendments to the HASP will be approved and implemented by the HSSC and the CHSSD, as needed. All site personnel will be informed of any revisions to the site-specific HASP and the resolution of any outstanding safety concerns prior to returning to their site functions. The necessary steps to ensure that operations can safely resume include:

- Ensure that all emergency equipment (e.g., fire extinguisher, communication system, first aid kits, and first aid station) is in functional order;
- Clear all incident-caused debris from the site, if safe to do so; and
- Inspect area and equipment.

NOTE: Specific emergency contact information is contained in the first and last pages of this HASP. Applicable directions to the nearest medical facility are contained in the last page to this HASP. In the event that an emergency situation occurs, *SECURE the safety of yourself and those working under your direction and then contact appropriate site and Ramboll representatives that are referenced in Table 1A of this HASP*

13. HEALTH & SAFETY PLAN FIELD TEAM SIGNATURES

Below is a signature table attesting that the HASP has been made available and reviewed by the individual prior to entry into the site.

Project Personnel List & Safety Plan Distribution Record

1. Ramboll Employees

All project staff must sign indicating they have read and understand the Site Health and Safety Plan. A copy of this Site Health and Safety Plan must be made available for their review and readily available at the job site.

Employee Name/ Job Title	Date Distributed	Signature

2. Subcontractors

A copy of this safety plan shall be provided to subcontractors who may be affected by activities covered under the scope of this Site Health and Safety Plan for their information only, although the subcontractors remain responsible for the safety of their own employees. All subcontractors must comply with applicable country, state and local government rules and regulations.

Firm Name	Contact Person	Date Distributed

Health and Safety Meeting

All personnel participating in the project must receive initial Health and Safety Orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the Site Health and Safety Officer (or at least once every 10 working days).

Date	Topics	Name of Attendee	Employee Firm Name	Initials

Visitor

It is Ramboll's policy that visitors must furnish their own personal protective equipment. All visitors are required to sign the visitor log and comply with Health and Safety Plan requirements. If the visitor represents a regulatory agency concerned with site health and safety issues, the Site Health and Safety Officer shall also immediately notify the HSSC.

Name of Visitor	Firm Name	Date of Visit	Signature

14. SAFETY MEETING CHECKLIST

The Site Supervisor should consider discussing the following topics with all field personnel conducting work as part of this HASP, as applicable.

Date and Time of Meeting:_____

Conducted By: _____

CHECK TOPIC(S) DISCUSSED:

HASP Content
- ☐ Chemicals of Concern
- ☐ Tasks to be Performed
- ☐ Location of Tasks
- ☐ Hazards/Risks of Tasks
- ☐ Site Limitations (e.g., cell phone use)

First Aid
- ☐ Facilities
- ☐ Reporting and Records
- ☐ Treatment of _____

Personal Protective Equipment
- ☐ Glasses, Goggles, and Shields
- ☐ Hard Hats
- ☐ Respirators
- ☐ Gloves
- ☐ Other _____

Emergency Procedures
- ☐ Communications
- ☐ Primary Rally Point:
- ☐ Secondary Rally Point:
- ☐ Headcount
- ☐ Hospital Location/Route
- ☐ PPE/Decon
- ☐ Other _____

Special Tools / Equipment
- ☐ Chain saws / Chop saws
- ☐ Other _____
- ☐ Other _____

HASP Content
- ☐ Personnel On-Site (Introductions)
- ☐ Responsibilities
- ☐ Monitoring equipment
- ☐ Other _____
- ☐ Other _____

Industrial Sanitation and Hygiene
- ☐ Drinking water
- ☐ Restrooms/Porta toilets
- ☐ Personal Cleanliness

Housekeeping
- ☐ Waste Containers
- ☐ Waste Materials
- ☐ Other _____

Fire Prevention
- ☐ Extinguisher Locations
- ☐ Designated Smoking Areas
- ☐ Hot Work
- ☐ Flammable Liquids Present
- ☐ Explosives Present
- ☐ Other _____

Vehicles/Heavy Equipment
- ☐ Transportation of Employees
- ☐ Operation and Inspection
- ☐ Preventative Maintenance
- ☐ Other _____

Discussion_____
_____
_____

APPENDIX A

CHEMICAL INFORMATION AND SAFETY DATA SHEETS

Hazardous Property Information

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)
Volatile Organic Compounds (VOCs)									
☐	Acetic acid (64-19-7)	Miscible	1.05	103	11 mm	4.0% 19.9%	10 ppm	50 ppm	0.074 (d)
☐	Acetone (67-64-1)	Miscible	0.79	0	180 mm	2.5% 12.8%	250 ppm	2,500 ppm	62 (d) 130 (r)
☐	Acrolein (107-02-8)	40%	0.84	-15	210 mm	2.8% 31%	C 0.1 ppm Skin	2 ppm	1.8 (d)
☐	Acrylonitrile (107-13-1)	7%	0.81	30	83 mm	3% 17%	2 ppm Skin	85 ppm Ca	1.6 (d)
☒	Benzene (71-43-2)	0.07%	0.88	12	75 mm	1.2% 7.8%	1 ppm Skin	500 ppm Ca	61 (d) 97 (r)
☐	Bromodichloro-methane (75-27-4)	4500 mg/l	1.98	--	50 mm	Non-flam	None established	None determined	--
☐	Bromoform (75-25-2)	0.10%	2.89	--	5 mm	Non-flam	0.5 ppm Skin	850 ppm	1.3 j
☐	Bromomethane (74-83-9)	2%	1.73	--	1.9 atm	10% 16.0%	1 ppm Skin	250 ppm Ca	80 j
☐	Carbon Tetrachloride (56-23-5)	0.05%	1.59	--	91 mm	Non-flam	2 ppm Skin	200 ppm Ca	252 (d)
☐	Chlorobenzene (108-90-7)	0.05%	1.11	82	9 mm	1.3% 9.6%	10 ppm	1000 ppm	1.3 (d)
☐	2-Chloroethyl-vinyl Ether (110-75-8)	0.02%	1.05	61	27 mm	--	None established	None determined	--
☐	Chloroethane (75-00-3)	0.60%	0.92	-58	1000 mm	3.8% 15.4%	100 ppm Skin	3800 ppm	4.2 j
☐	Chloroform (67-66-3)	0.50%	1.48	--	160 mm	Non-flam	2 ppm	500 ppm Ca	192 (d)
☐	Chloromethane (74-87-3)	0.50%	0.92	--	5 ATM	8.1% 17.4%	50 ppm	2000 ppm Ca	10 j
☐	Dibromo-chloromethane (124-48-1)	2700 mg/l	2.5	--	76 mm	--	None established	None Determined	--
☐	Dibutyl phthalate (84-74-2)	0.001% (77oF)	1.05	315	0.00007 mm	0.5% --	5 mg/m3	4,000 mg/m3	--
☐	1,2-Dichlorobenzene (95-50-1)	0.01%	1.3	151	1 mm	2.2% 9.2%	25 ppm Skin	200 ppm	--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)
☐	1,1-Dichloroethane (75-34-3)	0.60%	1.18	2	182 mm	5.4% 11.40%	100 ppm	3,000 ppm	--
☒	1,1-Dichloroethylene (DCE) (75-35-4)	0.04%	1.21	-2	500 mm	6.5% 15.5%	1 ppm	None determined	190 j
☐	1,2-Dichloroethane (107-06-2)	0.90%	1.24	56	64 mm	6.2% 16%	1 ppm	50 ppm Ca	26 (d) 87 (r)
☒	cis-1,2-Dichloroethene	Insoluable	1.28	6	201 mm	9.70% 12.80%	200 ppm	1,000 ppm	--
☐	1,2-Dichloroethylene (540-59-0)	0.40%	1.27	36-39	180-265 mm	5.6% 12.8%	200 ppm	1,000 ppm	17 - 170 k
☐	1,2-Dichloropropane (78-87-5)	0.30%	1.16	60	40 mm	3.4% 14.5%	75 ppm	400 ppm Ca	0.26 (d) 0.52 (r)
☐	1,3-Dichloropropene (542-75-6)	0.20%	1.21	77	28 mm	5.3% 14.5%	1 ppm Skin	None Determined Ca	1 j
☐	Bis-(2-Ethylhexyl)-phthalate (DEHP) (117-81-7)	0.00%	0.99	420	<0.01 mm	0.3% --	5 mg/m3	5,000 mg/m3 Ca	--
☐	Diethyl phthalate (84-66-2)	0.10%	1.12	322	0.002 mm	0.7% --	5 mg/m3	None Determined	--
☐	Dinitrotoluene (DNT) (25321-14-6)	Insoluble	1.32	404	1 mm	-- --	0.15 mg/m3 Skin	50 mg/m3 Ca	--
☐	Endrin (72-20-8)	Insoluble	1.7	--	0.00001 mm Low	--	0.1 mg/m3 Skin	2 mg/m3	--
☐	Ethyl benzene (100-41-4)	0.01%	0.87	55	7 mm	0.8% 6.7%	100 ppm	800 ppm	2.3 j
☐	Hydrazine (302-01-2)	Miscible	1.01	99	10 mm	2.9% 98%	0.01 ppm Skin	50 ppm Ca	3.7 (d)
☐	Methyl ethyl ketone (MEK) (78-93-3)	28%	0.81	16	78 mm	1.4% 11.4%	200 ppm	3000 ppm	16 (d) 17 (r)
☐	Methyl tert-butyl ether (MTBE) (1634-04-4)	5.1 g/100ml	0.7	-18	245 mm	1.6% 8.4%	40 ppm	None determined	0.32 – 0.47mg/m3 l

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)
☐	Methylene chloride (75-09-2)	2%	1.33	--	350 mm	13% 23%	25 ppm	2,300 ppm Ca	160 (d) 230 (r)
☐	Phenol (108-95-2)	9% (77oF)	1.06	175	0.4 mm	1.8% 8.6%	5 ppm Skin	250 ppm	0.06 (d)
☐	1,1,2,2-Tetrachloroethane (79-34-5)	0.30%	1.59	--	5 mm	Non-flam	1 ppm Skin	100ppm Ca	7.3 (d)
☒	Tetrachloroethylene (PCE) (127-18-4)	0.02%	1.62	--	14 mm	Non-flam	25 ppm	150 ppm Ca	47 (d) 71 (r)
☒	Toluene (108-88-3)	0.07% (74oF)	0.87	40	21 mm	1.1% 7.1%	10 ppm Skin	500 ppm	1.6 (d) 11 (r)
☐	1,1,1-Trichloroethane (71-55-6)	0.40%	1.34	--	100 mm	7.5% 12.5%	350 ppm	700 ppm	390 (d) 710 (r)
☐	1,1,2-Trichloro-ethane (79-00-5)	0.40%	1.44	--	19 mm	6% 15.5%	10 ppm Skin	100 ppm Ca	--
☐	1,2,4-Trichlorobenzene (120-82-1)	0.003%	1.45	222	1 mm	2.5% 6.6% (302 oF)	C 5 ppm	None Determined	3 j
☒	Trichloroethylene (TCE) (79-01-6)	0.1% (77oF)	1.46	--	58 mm	8% 10.5%	25 ppm	1,000 ppm Ca	82 (d) 110 (r)
☐	Trichlorofluoromethane (75-69-4)	0.1% (75oF)	1.47	--	690 mm	Non-flam	C 1,000 ppm	2000 ppm	--
☐	1,1,2-Trichloro-1,2,2-trifluoroethane (76-13-1)	0.02%	1.56	--	285 mm	-- --	1,000 ppm	2,000 ppm	--
☐	1,2,4-Trimethylbenzene (95-63-6)	0.006%	0.88	112	1 mm	0.9% 6.4%	25 ppm	None determined	2.4 (d)
☐	Vinyl Chloride (75-01-4)	0.1% (77oF)	0.91	--	3.3 atm	3.6% 33%	1 ppm Skin	None Determined Ca	--
☐	Xylene (o, p, m, mix) (1330-20-7)	Slightly soluble	0.86-0.88	81-90	7-9 mm	0.9% 7%	100 ppm	900 ppm	20 (d) 40 (r)

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)
Metals									
☐	Aluminum metal and oxide (as Al)	b	2.7	--	0 mm	e	10 mg/m3 (respirable)	None determined	--
☐	Antimony (7440-36-0)	b	6.69	--	0 mm	e	0.5 mg/m3	50 mg/m3	--
☒	Arsenic (inorganic compounds, as As)	b	5.73	--	0 mm	e	0.010mg/m3	5 mg/m3 Ca	--
☐	Arsenic (organic compounds, as As)	Properties vary depending upon the specific organic arsenic compound.					0.2mg/m3	None determined	--
☐	Barium chloride(as Ba) (10361-37-2)	38%	3.86	--	low	Non-flam	0.5 mg/m3	50 mg/m3	--
☐	Barium nitrate (as Ba) (10022-31-8)	9%	3.24	--	Low	e	0.5 mg/m3	50 mg/m3	--
☐	Beryllium and compounds (as Be)	b	1.85	--	0 mm	e	0.0002 mg/m3	4 mg/m3 Ca	--
☐	Cadmium dust (as Cd)	b	8.65	--	--	e	0.005 mg/m3	9 mg/m3 Ca	--
☐	Chromium (III) compounds (as Cr)	b	Properties vary depending upon the specific compound.				0.5 mg/m3	25 mg/m3	--
☐	Cobalt metal dust and fume (as Co) (7440-48-4)	Insoluble	8.92	--	0 mm	e	0.02 mg/m3	20 mg/m3	--
☒	Copper dust and mist (as Cu)	b	8.94	--	0 mm	e	1 mg/m3	100 mg/m3	--
☐	Lead	Insoluble	11.34	--	0 mm	e	0.05 mg/m3	100 mg/m3	--
☐	Manganese, Fume and compounds (as Mn) (7439-96-5)	Insoluble	7.2	--	0 mm	Comb-ustible	0.2 mg/m3	500 mg/m3	--
☐	Mercury compounds (as Hg) Except alkyl compound	b	13.6	--	0.0012 mm	e	0.025 mg/m3 Skin	10 mg/m3	--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)
☐	Molybdenum (7439-98-7)	Insoluble	10.28	--	0 mm	Comb-ustible	10 mg/m3 3 mg/m3 (resp.)	5,000 mg/m3	--
☒	Nickel and other compounds (as Ni)	Insoluble	8.9	--	0 mm	e	1 mg/m3	10 mg/m3 Ca	--
☐	Selenium (7782-49-2)	Insoluble	4.28	--	0 mm	Comb-ustible	0.2 mg/m3	1 mg/m3	--
☐	Silver, metal dust, and soluble compounds (as Ag)	b	10.49	--	0 mm	e	0.01 mg/m3	10 mg/m3	--
☐	Thallium (soluble compounds, as Ti)	b	Properties vary depending upon the specific compound.				0.1 mg/m3 Skin	15 mg/m3	--
☐	Vanadium pentoxide dust and Fume (1314-62-1)	0.8%	3.36	--	0 mm	e	0.05 mg/m3 (Respirable)	35 mg/m3	--
☒	Zinc oxide (1314-13-2)	b	5.61	--	0 mm	e	5 mg/m3	500 mg/m3	--
Miscellaneous									
☐	Ammonia (7664-41-7)	34%	--	--	8.5 atm	15% 28%	25 ppm	300 ppm	17 (d)
☒	Asbestos (1332-21-4)	Insoluble	--	--	0 mm	Non-flam	0.1 fibers/cc	None determined	--
☐	Chromic Acid and chromates (1333-82-0)	63%	2.7	--	Very low	Non-flam	0.005 mg/m3	15 mg/m3 Ca	--
☐	Cyanide (as CN)	--	--	--	--	Non-flam	5 mg/m3 Skin	--	--
☐	DDT (50-29-3)	Insoluble	0.99	162-171	0.0000002 mm	--	1 mg/m3 Skin	500 mg/m3 Ca	--
☒	Diesel Fuel #2 (68476-34-6)	Insoluble	0.81-0.90	130	--	0.6-1.3 6-7.5	None established	None determined	--
☐	Fluorides, as F	--	--	--	--	--	2.5 mg/m3	None determined	--
☒	Gasoline (8006-61-9)	Insoluble	0.72-0.76	-45	38-300 mm	1.4% 7.6%	300 ppm	Ca None determined	--
☒	Hydrochloric Acid (7647-01-0)	67%	'--	'--	40.5 atm	'--	5 ppm	50 ppm	'--

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)
☐	Kerosene (8008-20-6)	Insoluble	0.81	100-162	5 (100oF)	0.7% 5.0%	200 mg/m3g Skin	None determined	--
☐	Methanol (67-56-01)	Miscible	0.79	52	96 mm	6% / 36%	200 ppm	6000 ppm	'--
☐	Naphthalene (91-20-3)	0.003%	1.15	174	0.08 mm	0.9% 5.9%	10 ppm	250 ppm	0.038 (d)
☒	Nitric Acid	Miscible	1.50	'--	48 mm	'--	2 ppm	25 ppm	'--
☐	PCB (42% chlorine) (53469-21-9)	Insoluble	1.39	--	0.001 mm	Non-flam	1 mg/m3 Skin	5 mg/m3 Ca	--
☐	PCB (54% chlorine) (11097-69-1)	Insoluble	1.38	--	0.00006 mm	Non-flam	0.5 mg/m3 Skin	5 mg/m3 Ca	--
☐	Phosphorus (yellow) (7723-14-0)	0.0003%	1.82	--	0.03 mm	-- --	0.1 mg/m3	5 mg/m3	--
☐	Polycyclic Aromatic Hydrocarbons (PAH)	Properties vary depending upon the specific compound. Listed in NIOSH as Coal Tar Pitch Volatiles					0.2 mg/m3	80 mg/m3 Ca	--

SITE-SPECIFIC SUBSTANCES
(Add hazardous property information on any substances that are of concern at the site but are not listed above.)

Check if Present	Material (CAS #)	Water Solubility [a]	Specific Gravity	Flash Point (°F)	Vapor Pressure [d]	LEL UEL	Cal/OSHA PEL- TWA [f]	IDLH Level [h]	Odor Threshold Geometric mean[i] (ppm)

EXPLANATIONS AND FOOTNOTES:

a. Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water, such as gasoline. However, most of these materials are water soluble at the part per million or part per billion level. Gasoline, for example, is insoluble in the gross sense, and will be found as a discrete layer on top of the groundwater. But certain gasoline constituents, such as benzene, toluene, and xylene, will also be found in solution in the groundwater at the part per million or part per billion levels.

b. Solubility of metals depends on the compound in which they are present.

c. Several chlorinated hydrocarbons exhibit no flash point in a conventional sense, but will burn in the presence of high energy ignition source or will form explosive mixtures at temperatures above 200 degrees F.

d. Expressed as mm Hg under standard conditions.

e. Explosive concentrations of airborne dust can occur in confined areas.

f. Cal/OSHA Time-weighted Average (TWA) Permissible Exposure Limits (PELs) except where noted in g. The substances designated by "Skin" in the PEL column may be absorbed into the bloodstream through the skin, the mucous membranes and/or the eye, and contribute to the overall exposure. “C” notation indicates the number given is a ceiling value.

g. TLV-TWA adopted by the American Conference of Governmental Industrial Hygienists (ACGIH). Currently, there is no Cal/OSHA PEL.

h. The substances with a “Ca” notation in the IDLH column are considered to be potential occupational carcinogens by NIOSH.

i. Odor thresholds values extracted from “ODOR THRESHOLDS for Chemicals with established Occupational Health Standards”, American Industrial Hygiene Association, 1997.

(d) Odor detection threshold: Lowest concentration at which a stimulus is being detected.

(r) Odor recognition threshold: Lowest concentration at which a definite odor character is detected.

j. Values extracted from the U.S. Environmental Protection Agency Technology Transfer Network, Air Toxics website. URL: www.epa.gov/ttn/atw/, 2006

k. Value extracted from “HESIS Guide to Solvent Safety” California Department of Health Services, 2004. URL: http://www.dhs.ca.gov/ohb/HESIS/solv_cht.htm

l. Value extracted from “Chemical Summary For Methyl-Tert-Butyl Ether”, U.S. Environmental Protection Agency, Office Of Pollution Prevention and Toxics, August 1994. URL: http://www.epa.gov/chemfact/s_mtbe.txt

MATERIAL SAFETY DATA SHEET

1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT(S): STEEL - A50, 301, 301L, 302, 302B, 304, 304H, 304L, 304LN, 304N, 305, 316, 316L, 316LN, 316TI, 317, 317L, 317LX, 317LXN, 317XN, 321, 321H, 347, 348, 388, A610, A611, 850, AL 13-8, 307

MSDS CATEGORY: I-B

MANUFACTURER:

ALLEGHENY LUDLUM CORPORATION
100 RIVER ROAD
BRACKENRIDGE, PA 15014

DESCRIPTION: Solid product, various forms and uses

EMERGENCY PHONE: 724-226-5555

INFO. PHONE: 724-226-5980 (M-F, 9 a.m.-4:30 p.m. EST)

CHEMTREC: 800-424-9300

DATE OF APPROVAL: 05-23-2005

2 - COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENT	CAS NUMBER	PERCENTAGE BY WEIGHT	OSHA PEL	ACGIH TLV
Iron	7439-89-6	52 – 78	10 mg/m^3, Iron Oxide form, fume	5 mg/m^3, Iron Oxide form, dust and fume
Chromium	7440-47-3	12 – 24	1 mg/m^3, metal and insoluble salts 0.5 mg/m^3, Cr (III) compounds 0.1 mg/m^3, Cr (VI) compounds	0.5 mg/m^3, metal and Cr (III) compounds 0.05 mg/m^3, Cr (VI) water soluble compounds 0.01 mg/m^3, Cr (VI) water insoluble compounds
Nickel	7440-02-0	6.0 – 19	1 mg/m^3, metal and insoluble compounds	1.5 mg/m^3, metal 0.1 mg/m^3, soluble compounds 0.2 mg/m^3, insoluble compounds
Molybdenum	7439-98-7	0 - 5.0	5 mg/m^3, soluble Mo compounds (as Mo) 15 mg/m^3, insoluble Mo compounds, total dust (as Mo)	5 mg/m^3, soluble Mo compounds (as Mo) 10 mg/m^3, insoluble Mo compounds (as Mo)
Silicon	7440-21-3	0 – 6.5	15 mg/m^3, total dust 5 mg/m^3, respirable fraction	10 mg/m^3, total dust
Manganese	7439-96-5	0 - 2.0	5 mg/m^3 Ceiling, Mn compounds and Mn fume (as Mn)	0.2 mg/m^3, elemental and inorganic compounds (as Mn)
Tungsten	7440-33-7	0 - 1.8	15 mg/m^3, total dust (PNOR) 5 mg/m^3, respirable fraction (PNOR) (not regulated)	1 mg/m^3, 3 mg/m^3 STEL soluble W compounds (as W) 5 mg/m^3, 10 mg/m^3 STEL insoluble W compounds (as W)
Aluminum	7429-90-5	0 - 1.5	15 mg/m^3, metal, total dust (as Al) 5 mg/m^3, metal, respirable fraction (as Al)	10 mg/m^3, metal dust 5 mg/m^3, welding fume
Columbium	7440-03-1	0 - 1.0	15 mg/m^3, total dust (PNOR) 5 mg/m^3, respirable fraction (PNOR) (not regulated)	10 mg/m^3, total dust (PNOC) (not classified)
Titanium	7440-32-6	0 - 0.7	15 mg/m^3, Titanium Dioxide form, total dust	10 mg/m^3, Titanium Dioxide form, total dust
Copper	7440-50-8	0 – 1.5	0.1 mg/m^3, fume (as Cu) 1 mg/m^3, dust and mist (as Cu)	0.2 mg/m^3, fume (as Cu) 1 mg/m^3, dusts and mists (as Cu)
Cobalt	7440-48-4	0 - 1.0	0.1 mg/m^3, metal, dust, and fume (as Co)	0.02 mg/m^3, elemental and inorganic compounds (as Co)

NOTE: 1) All exposure limits are 8-hour TWAs unless otherwise specified. 2) As defined by OSHA, STEL (Short Term Exposure Limit) is an employee's fifteen-minute, time-weighted average exposure, which must not be exceeded during a workday. 3) All commercial metals may contain small amounts of various elements in addition to those specified. These small quantities (less than 0.1%), frequently referred to as "trace" or "residual" elements, generally originate in the raw material used. These elements may include, but are not limited to the following: Sulfur, Phosphorous, Nitrogen, Aluminum, Arsenic, Boron, Cadmium, Calcium, Lead, Tin, Titanium, Vanadium, and Zirconium. Abbreviations and acronyms are defined in Section 16.

3 - HAZARDS IDENTIFICATION

GENERAL HAZARD STATEMENT: Solid metallic products distributed by Allegheny Ludlum are generally classified as "articles" and do not constitute a hazardous material in solid form under the terms of the OSHA Hazard Communication Standard. Any articles manufactured from these solid products would be generally classified as non-hazardous. However, some metallic elements contained in these products have been determined to be toxic and are subject to regulatory controls. These elements can be emitted as airborne contaminants under certain processing conditions such as burning, melting, cutting, sawing, brazing, grinding, milling, machining.

Certain materials and equipment utilized in processing of steel products (cutting/machining fluids, coatings, processing lubricants, cleaning/pickling chemicals, welding fluxes, torch and plasma cutting systems) may constitute a health hazard and should be treated accordingly.

EMERGENCY OVERVIEW: Odorless solid product in various forms, silver-gray color. This formed solid metal product poses little or no immediate health or fire hazards. Product may be coated - refer to appropriate coating MSDS for physical and health hazards. When product is subjected to welding, burning, melting, sawing, brazing, grinding, or other similar processes, potentially hazardous airborne particulate and fumes may be generated. These operations should be performed in well-ventilated areas, and if appropriate, respiratory protection and other PPE should be utilized.

PRIMARY ROUTE OF ENTRY: Inhalation of dust or fume during welding, burning, melting, cutting, brazing, grinding, machining and other operations.

NOTE: The composition of fumes from welding are dependent not only on the metal being welded, but also on the welding process and electrodes used. A full health hazard assessment should be performed by a competent health and safety professional for all welding and other operations performed on this product.

Acute Effects of Overexposure:

INHALATION:
- Exposures to high concentrations of metallic fumes or dusts may result in irritation of the respiratory tract and/or sensitization of the lungs and other mucous membranes.
- Excessive inhalation of fumes from many metals can produce an acute reaction known as "metal fume fever" (symptoms shown below under *SIGNS AND SYMPTOMS OF OVEREXPOSURE*).

EYE:
- Exposure to high concentrations of fumes or dusts may cause irritation and/or sensitization.

SKIN:
- Exposure to dust may cause irritation or sensitization, possibly leading to dermatitis.

INGESTION:
- Ingestion of harmful amounts of product as distributed is unlikely due to its solid, insoluble form. Ingestion of dust may cause nausea and/or vomiting. Serious effects may occur if large amounts of dust are swallowed.

Chronic Effects of Overexposure:

EXCESSIVE AND REPEATED EXPOSURES TO FUME OR DUST GENERATED DURING PROCESSING MAY CAUSE:
- Allergic sensitization - dermatitis and asthma
- Lung inflammation and damage - pneumonitis, pneumonia, bronchitis, siderosis (benign lung disease caused by inhaling iron particles), diffuse pulmonary fibrosis
- Nasal perforation and nasal cavity damage
- Eye inflammation
- Central nervous system damage, possibly permanent
- Kidney damage
- Liver damage
- Gout - inflammation of the joints (associated with some metals)

CARCINOGENICITY:
- The carcinogenicity of this solid product as a whole has not been tested. Individual components and some compounds of these elemental metals may have been associated with carcinogenicity by NTP and IARC.
- No component greater than 0.1% by weight within this solid product is regulated by OSHA within 29 CFR 1910 Subpart Z as a carcinogen.

SYNERGISTIC MATERIALS: Inhalation of high concentrations of Iron Oxide may possibly enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens.

SIGNS AND SYMPTOMS OF OVEREXPOSURE:

- Redness, swelling, itching, and/or irritation of skin and eyes
- Respiratory difficulties - coughing, wheezing, shortness of breath, dyspnea, decreased pulmonary function
- Metal fume fever - symptoms consist of chills and fever (very similar and easily confused with flu symptoms), a metallic taste in the mouth, dryness and irritation of the throat. The symptoms occur a few hours after excessive exposures and usually last from 12 to 48 hours. Long term effects from metal fume fever have not been noted in the literature.
- Central nervous system effects may show languor, sleepiness, weakness, emotional disturbances, spastic gait, paralysis.
- Kidney damage may be seen as changes in urine output and appearance, lower back pain, and edema (swelling from fluid retention).
- Liver damage may be seen by loss of appetite, jaundice (yellowish skin color) and occasional pain in the upper abdomen on the left side.
- Anorexia and Weight loss

NOTE: For specific toxicological and other chronic effects information concerning the components of this solid steel product, *refer to SECTION 11.0, TOXICOLOGICAL INFORMATION*.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: For airborne fume and dust, preexisting diseases of the lungs, skin, eyes, and other mucous membranes. Inhalation of high concentrations of Iron Oxide may possibly enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens.

4 - FIRST AID MEASURES

INHALATION: If overexposure occurs, immediately remove victim from the adverse environment to fresh air and seek medical attention. If breathing has stopped, certified individuals should perform CPR. Keep affected person warm and at rest.

EYE: Immediately flush with large amounts of running water for several minutes. Seek prompt medical attention.

SKIN: If dust gets on skin, wash contaminated area with soap and water. Remove and wash contaminated clothing. If a persistent rash or irritation occurs, seek medical attention.

INGESTION: Get medical attention immediately.

5 - FIRE FIGHTING MEASURES

FLASH POINT (Method Used): N/A

FLAMMABLE LIMITS: N/A

AUTOIGNITION TEMPERATURE: N/A

GENERAL FIRE HAZARD: None for solid formed product

FLAMMABILITY CLASSIFICATION: N/A

EXTINGUISHING METHOD: For solid formed product, as appropriate for surrounding fire. A fire involving finely divided particles should be treated as a Class D combustible metal fire. Fire should be extinguished by a properly trained and experienced firefighter. Proper care should be taken in applying extinguishing agent and in allowing to burn itself out.

FIRE FIGHTING EQUIPMENT: For solid formed product, as appropriate for surrounding fire. Positive pressure SCBA and structural firefighter's protective clothing should be used at a minimum for surrounding fire.

UNUSUAL FIRE OR EXPLOSION HAZARDS: This solid formed product does not constitute a fire or explosion hazard. Finely divided, suspended particulates may present a fire and explosion hazard in the presence of an ignition source. In addition, applied coatings may be combustible. For fires involving coated product, consult the appropriate coating MSDS.

Finely divided product (e.g. dust, shavings, etc.) may be combustible. May be ignited by heat, sparks, or flames. May burn rapidly with flare-burning effect. Fire may produce irritating or poisonous gases. High concentrations of airborne dust in an enclosed area can explode or burn if exposed to a source of ignition. Care should be taken to avoid the generation of airborne dust. Use of water on finely divided product may cause explosive hydrogen gas and heat to be evolved.

EXPLOSION DATA: *Sensitivity/Mechanical Impact*: N/A for solid product *Sensitivity/Static Discharge*: N/A for solid product

HAZARDOUS COMBUSTION PRODUCTS: N/A for solid formed product. Toxic metal and metallic oxide fumes may be evolved from fires involving finely divided particles and during torch-cutting operations.

6 - ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED: Minimal problems with spills of this product would occur because of its solid form. The following precautions apply to spills involving finely divided particles:

- Shut off ignition sources; no flares, smoking or flames should be in or near hazard area.
- Do not touch or walk through spilled material. Clean up using methods which avoid dust generation.
- Compressed air should not be used to clean up spills.
- During cleanup, skin and eye contact and inhalation of dust should be avoided as much as possible.
- Provide local exhaust or dilution ventilation as required.
- Appropriate PPE should be worn during cleanup if exposure limits are exceeded (*see SECTION 8, EXPOSURE CONTROLS/PERSONAL PROTECTION*).
- Collect material in compatible and appropriately labeled containers.
- For small dry spills, place material into clean dry container with a clean shovel, and cover loosely; move container from spill area.
- Comply with federal, state, and local regulations regarding reporting of spills and waste disposal.

7 – HANDLING AND STORAGE

HANDLING: Avoid breathing of and contact with fumes and dusts during processing. No specific requirements for solid formed steel product.

STORAGE: Keep away from incompatible materials (*see SECTION 10, STABILITY AND REACTIVITY*). No other specific storage procedures are required for solid formed steel product.

8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Local and/or general exhaust ventilation should be used to keep worker exposure below applicable exposure limits (*see SECTION 2, COMPOSITION/INFORMATION ON INGREDIENTS, for PELs and TLVs*) during welding, brazing, grinding, machining, and other processes which may generate airborne contaminants.

RESPIRATORY: When engineering or administrative controls cannot maintain exposures below permissible limits during welding, brazing, machining, and other processes which may generate airborne contaminants or while being instituted, use an appropriate NIOSH/MSHA approved respirator. If respiratory protection is required, all appropriate requirements as set forth in 29 CFR 1910.134 must be met. A competent health and safety professional should be consulted for respirator selection, fit testing, and training. Use a NIOSH-approved positive-pressure, air-supplied respirator if exposure levels are unknown, or any other circumstance where an air-purifying respirator would not be adequate.
GLOVES: Suitable for protection against physical injury and skin contact during handling and processing.

EYE: Safety glasses or goggles when there is a reasonable probability of flying particles or high levels of airborne dust or fume.

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Adequate footwear (safety shoes if necessary) and clothing that protects skin from prolonged or repeated contact. Change clothing if there is a reasonable probability of contamination.

9 - PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point: NIF for steel product(Fe-5432/Cr-3992/Ni-5252 ^{o}F)

Vapor Pressure (mm Hg, @ 68 ^{o}F): Negligible

Vapor Density (AIR = 1): N/A

Melting Point: NIF for steel product(Fe-2797/Cr-3452/Ni-2651 ^{o}F)

Appearance and Odor: Silver-gray metallic solid form, odorless

Specific Gravity (H_2O = 1): 7 –

Evaporation Rate: N/A

Solubility in water: Insoluble

pH: N/A

10 - STABILITY AND REACTIVITY

STABILITY: Stable under normal conditions of use, storage and transport for solid formed product.

CONDITIONS TO AVOID: Contact with incompatible materials. Avoid creating finely divided, concentrated airborne particulates in the presence of ignition sources.

INCOMPATIBLE MATERIALS: Oxidizers. Reacts with strong acids to form explosive hydrogen gas and heat.

HAZARDOUS DECOMPOSITION PRODUCTS: Extreme heat from fire or processing (e.g. welding, brazing, machining, etc.) may produce toxic or irritating airborne particulate, including metal and metallic oxide fumes. Reaction of some metals with water, steam, acids, etc. can evolve hydrogen, which is a highly dangerous fire and explosion hazard.

HAZARDOUS POLYMERIZATION: Will not occur

11 - TOXICOLOGICAL INFORMATION

Iron: Excessive exposure of eyes to airborne iron dust can cause conjunctivitis, choroiditis, and retinitis. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in development of a benign pneumoconiosis, called siderosis, which is observable via x-ray. No physical impairment of lung function has been associated with siderosis. Inhalation of excessive concentrations of iron oxide may enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens. LD50 (oral, rat) - 30 gm/kg; LC50 - NIF.

Chromium: The health hazards associated with exposure to chromium are dependent on its oxidation state. The metal form (chromium as it exists in this product) is of low toxicity. The hexavalent form and some trivalent forms are toxic. Adverse effects of the hexavalent form on the skin may include ulcerations, dermatitis, and allergic skin reactions. Inhalation of hexavalent chromium compounds can result in ulceration and perforation of the mucous membranes of the nasal septum, irritation of the pharynx and larynx, asthmatic bronchitis, bronchospasms and edema. Respiratory symptoms may include coughing and wheezing, shortness of breath, and nasal itch. LD50 (oral) - NIF; LC50 - NIF.

Carcinogenicity - Chromium and most trivalent chromium compounds have been listed by NTP as having inadequate evidence for carcinogenicity in experimental animals. According to NTP, there is sufficient evidence for carcinogenicity in experimental animals for the following hexavalent chromium compounds: calcium chromate, chromium trioxide, lead chromate, strontium chromate, and zinc chromate. IARC has listed chromium metal and its trivalent compounds within Group 3 (The agent is not classifiable as to its carcinogenicity to humans). Chromium is not regulated as a carcinogen by OSHA (29 CFR 1910 Subpart Z). ACGIH has classified chromium metal and trivalent chromium compounds as A4, not classifiable as a human carcinogen. Water soluble hexavalent chromium compounds have been classified by ACGIH as A1, confirmed human carcinogen.

Nickel: Nickel fumes are respiratory irritants and may cause pneumonitis. Exposure to nickel and its compounds may result in the development of a dermatitis known as "nickel itch" in sensitized individuals. The first symptom is usually itching, which occurs up to 7 days before skin eruption occurs. The primary skin eruption is erythematous, or follicular, which may be followed by skin ulceration. Nickel sensitivity, once acquired, appears to persist indefinitely. LC50 - NIF; LD50 (oral) - NIF.

Carcinogenicity - Nickel and certain nickel compounds have been listed by NTP as being reasonably anticipated to be carcinogens. IARC has listed nickel compounds within group 1 (there is sufficient evidence for carcinogenicity in humans) and nickel within group 2B (agents which are possibly carcinogenic to humans). Nickel is not regulated as a carcinogen by OSHA (29 CFR 1910 Subpart Z). Based upon epidemiological data, ACGIH (1998) has designated elemental nickel as category A5, not a suspected human carcinogen.

Molybdenum: Based on animal experiments, molybdenum and its compounds are highly toxic. Some evidence of liver dysfunction with hyperbilirubinemia have been reported in workmen chronically exposed in a Soviet Mo-Cu plant. In addition signs of gout have been found in factory workers and among inhabitants of Mo-rich areas of Armenia. The main features were joint pains in the knees, hands, feet, articular deformities, erythema, and edema of the joint areas. LD50 (oral) - NIF; LC50 - NIF.

Silicon: Elemental silicon is an inert material which appears to lack the property of causing fibrosis in lung tissue. However, slight pulmonary lesions have been reported in laboratory animals from intratracheal injections of silicon dust. Silicon dust has little adverse affect on lungs and does not appear to produce significant organic disease or toxic effects when exposures are below permissible limits. Silicon may cause chronic respiratory effects. Crystalline silica (silicon dioxide) is a potent respiratory hazard. However, the likelihood of crystalline silica generation during normal processing is very remote. LD50 (oral) - 3160 mg/kg rat; LC50 - NIF.

Manganese: Chronic manganese poisoning may result from prolonged inhalation of manganese dust and fumes. The central nervous system is the chief site of damage from the disease, which may result in permanent disability. Symptoms include languor, sleepiness, weakness, emotional disturbances, spastic gait, recurring leg cramps, and paralysis. A high incidence of pneumonia and other upper respiratory infections has been found in workers exposed to dust or fume of manganese compounds. Manganese compounds are experimental equivocal tumorigenic agents. LD50 (oral, rat) - 30 gm/kg; LC50 - NIF; TCLo - 2300 $\mu g/m^3$ (man).

Aluminum: Inhalation of finely divided aluminum and aluminum oxide powder has been reported as a cause of pulmonary fibrosis and lung damage. This effect, known as Shaver's Disease, is complicated by the presence in the inhaled air of silica and oxides of iron. May also be implicated in Alzheimer's disease. LD50 (oral) - NIF; LC50 - NIF.

Tungsten: Tungsten has been shown to act by antagonizing the action of the essential trace element, Molybdenum. Tungsten metal powder administered to animals has been shown in several studies as not totally inert. One study found that guinea pigs treated orally or intravenously with tungsten suffered from anorexia, colic, incoordination of movement, trembling, dyspnea and weight loss. Long industrial experience has indicated no pneumoconiosis to develop among workers exposed solely to tungsten or its insoluble compounds (at air concentrations of the order of 5 mg/m^3). In NIOSH's criteria document, two Russian studies were cited which indicated and incidence of 9-11% pulmonary fibrosis among employees exposed to tungsten without cobalt co-exposure. LD50 (intraperitoneal) - 5 g/kg rat; LC50 - NIF.

Columbium: Interferes with calcium as an activator of enzyme systems. LD50 (oral) - NIF; LC50 - NIF.

Titanium: Elemental titanium and titanium dioxide is of a low order of toxicity. Laboratory animals (rats) exposed to titanium dioxide via inhalation have developed small localized areas of dark-colored dust deposits in the lungs. Excessive exposure in humans may result in slight changes in the lungs. LD50 (oral) - NIF; LC50 - NIF.

Copper: Industrial exposure to copper fumes, dusts, or mists may result in metal fume fever with atrophic changes in nasal mucous membranes. Chronic copper poisoning results in Wilson's Disease, characterized by a hepatic cirrhosis, brain damage, demyelination, renal disease, and copper deposition in the cornea. Copper fume (respirable) has appeared on the ACGIH Notice of Intended Changes (1996 & 1997). The intended ACGIH TLV for respirable copper fume is 0.05 mg/m^3. LD50 (oral) - NIF; LC50 - NIF.

Cobalt: Cobalt dust may cause an asthma-like disease with symptoms ranging from cough, shortness of breath and dyspnea to decreased pulmonary function, nodular fibrosis, permanent disability, and death. Exposure to cobalt may cause weight loss, dermatitis, and respiratory hypersensitivity. LD50 (oral, rat) - 6171 mg/kg; LC50 - NIF.

Carcinogenicity - IARC has listed cobalt and cobalt compounds within group 2B (agents which are possibly carcinogenic to humans). ACGIH has placed cobalt and inorganic compounds in category A3 (Experimental animal carcinogen - the agent is carcinogenic in experimental animals at a relatively high dose, by route(s), histologic type(s), or by mechanism(s) that are not considered relevant to worker exposure. Cobalt has been classified by the Federal Republic of Germany to be carcinogenic to experimental animals.

12 - ECOLOGICAL INFORMATION

N/A for solid steel product in its as shipped form. Articles produced from solid product are not an ecological hazard. NIF on specific product to establish its effect if released into the environment in finely divided form. It is believed that finely divided product, based on its components, will be hazardous to fish, animals, plants and the environment if released, the degree of which would depend on the particle size and quantity released. In addition, if particles are small enough, material may be ingested by wildlife, with possible toxic effects. The solid product is not expected to migrate easily into soil or groundwater based upon its insoluble form, however, finely divided material can become mobile in water and contaminate soil and groundwater. This material may persist in the environment for long periods, based upon its corrosion resistant, insoluble, and non-biodegradable properties. In addition, heavy metals may contaminate the food chain and ultimately be consumed by humans. Some components will react with oxygen to form metallic oxides; the rate of oxidation depends upon prevailing conditions. Iron oxidizes most rapidly in moist air. Metallic particulate discharged to a POTW may pass-through or contaminate sewage sludge, may interfere with the treatment system process, and may be non-compliant with a POTW permit or other regulations.

13 - DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: If product as shipped becomes a solid waste, it would not be classified as a hazardous waste, and should be recycled. Product dusts from processing may be classified as a hazardous waste, depending on various properties of the dust (e.g. toxicity, solubility, flammability), which are defined further within 40 CFR 261 and possibly more restricting state and/or local regulations. Solid waste generated from product processing should be classified by a competent environmental professional and disposed, processed, or recycled in accordance with federal, state and local regulations.

14 - TRANSPORT INFORMATION

HAZARDOUS MATERIALS DESCRIPTION/PROPER SHIPPING NAME: N/A for solid formed product.

HAZARD CLASS: N/A for solid formed product.

IDENTIFICATION NO.: N/A for solid formed product.

15 - REGULATORY INFORMATION

SARA TITLE III HAZARD CATEGORIZATION: Product (dust and fume) is categorized as an immediate (acute) health hazard and a delayed (chronic) health hazard as defined by 40 CFR 370.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (EHSs): No components are listed as extremely hazardous substances.

SARA TITLE III SECTION 313 REPORTABLE SUBSTANCES: Nickel, Chromium, Cobalt, Aluminum (fume or dust), and Manganese are subject to reporting requirements (Copper is less than the 1% de minimis level).

CERCLA HAZARDOUS SUBSTANCES: Nickel* (threshold 100 lbs.), Chromium* (threshold 5000 lbs.), and Copper* (threshold 5000 lbs.). *Note: CERCLA reporting only if diameter of particles released is less than 100 micrometers.

PENNSYLVANIA R-T-K LIST: Listed components (greater than 0.1 % by weight) - Aluminum (E), Manganese (E), Molybdenum, Nickel (E,S), Silicon, Chromium (E,S), Cobalt (E), Copper (E), and Tungsten. E - environmental hazard, S - special hazardous substance.

NEW JERSEY R-T-K ENVIRONMENTAL HAZARDOUS SUBSTANCE LIST: Listed components - Aluminum (as dust and fume), Chromium, Cobalt, Copper, Manganese, and Nickel.

CALIFORNIA PROPOSITION 65: Listed possible trace (much less than 0.1% by weight) elements known by the state to cause cancer - Arsenic (inorganic), Cadmium, Lead; Listed possible trace elements known by the state to cause reproductive toxicity - Lead; Listed components known by the state to cause cancer - Nickel, Cobalt (metal powder); Listed components known by the state to cause reproductive effects - None.

16 - OTHER INFORMATION

NFPA RATING (for solid formed product): Health: 1 Flammability: 0 Reactivity: 0
HMIS RATING (for solid formed product): Health: 1 Flammability: 0 Reactivity: 0 PPE: B

ABBREVIATIONS/ACRONYMS:

ACGIH	- American Conference of Governmental Industrial Hygienists	NIF	- No Information Found
CAS	- Chemical Abstracts Service	NIOSH	- National Institute for Occupational Safety and Health
CFR	- Code of Federal Regulations	NTP	- National Toxicology Program
CPR	- Cardiopulmonary Resuscitation	OSHA	- Occupational Safety and Health Administration
EST	- Eastern Standard Time	PEL	- Permissible Exposure Limit
HMIS	- Hazardous Materials Identification System	PNOR	- Particulate Not Otherwise Regulated
IARC	- International Agency for Research on Cancer	PNOC	- Particulate Not Otherwise Classified
mg/m3	- milligram per cubic meter of air	POTW	- Publicly Owned Treatment Works
mppcf	- million particles per cubic foot	PPE	- Personal Protective Equipment
MSDS	- Material Safety Data Sheet	ppm	- parts per million
MSHA	- Mine Safety and Health Administration	SCBA	- Self-contained Breathing Apparatus
N/A	- Not Applicable	STEL	- Short-term Exposure Limit
NFPA	- National Fire Protection Association	TLV	- Threshold Limit Value

NIA - No Information Available TWA- Time-weighted Average

NOTE: The percent composition in Section 2 reflects the range that is possible within this GROUP of products. These are not the technical specifications for a particular product. Also, specific grades may not include all of the hazardous ingredients in Section 2.

DISCLAIMER: All information, recommendations, and suggestions appearing herein concerning the product are based upon data believed to be reliable. It is the user's responsibility to determine the safety, toxicity, and suitability for their own use of the product described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied is made by AM Health and Safety, Inc. (AMH&S-acting consultant) and Allegheny Ludlum as to the effects of such use, the results to be obtained, or the safety and toxicity of the product, nor does AMH&S or Allegheny Ludlum assume any liability arising out of use by others of the product referred to herein. AMH&S and Allegheny Ludlum shall not in any event be liable for special, incidental or consequential damages in connection with this MSDS. This MSDS is not intended as a license to operate under, or recommendation to infringe on, any patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

This information is not intended to serve as a complete regulatory compliance document. This information is offered as a guide to the MSDS user. No guarantees can be made whether the user will be in complete or correct compliance with all applicable regulations when this MSDS is used. It is the user's responsibility to comply with all federal, state, and local regulations.

PREPARED BY: AM Health and Safety, Inc. (acting consultant)	**REVISION NO.**: 11A	**APPROVAL DATE**: May 23, 2005
MFR. CONTACT: M.R. Shirey (724-226-5980)	**SUPERSEDES MSDS DATED**: September 15, 2004	

SDS

(Safety Data Sheet)

Tungsten Electrodes

Revised 03/10/2017

This Safety Data Sheet (SDS) is for welding consumables and related products and may be used to comply with OSHA's Hazard Communication standard, 29 CFR 1910.1200, Superfund Amendments and Reauthorization Act (SARA) of 1986 Public Law 99-499 and Canadian Workplace Hazardous Materials Information System (WHMIS) per Health Canada administrative policy. The OSHA standard must be consulted for specific requirements. This Safety Data Sheet complies with ISO 11014-1 and ANSI Z400.1

Section 1: Identification

Manufacturer/Supplier: American Filler Metals Company

Address: 6015 Murphy Street, Houston, TX 77033

Web Site: www.amfiller.com

Trade Name: AFM Pure Tungsten (EWP), AFM 1% Thoriated Tungsten (EWTh-1), AFM 2% Thoriated Tungsten (EWTh-2), AFM 2% Ceriated Tungsten (EWCe-2), AFM 1.5% Lanthanated (EWG), 2% Lanthanated Tungsten (EWLa-1), AFM Zirconate Tungsten (EWZr-1)

Telephone No.: (713) 649-8785

Emergency No.: Chemtrec: (800) 424-9300

Classification:

AWS A5.12

(Tungsten and Oxide Dispersed Tungsten Electrodes for Arc Welding and Cutting)

Section 2: Hazard(s) Identification

Emergency Overview: Grey metal rods with no odor.
These products are normally not considered hazardous as shipped. Gloves should be worn when handling to prevent contaminating hands with product dust.
Avoid eye contact or inhalation of dust from these products. Skin contact is normally no hazard but should be avoided to prevent possible allergic reactions.
Persons with a pacemaker should not go near welding or cutting operations until they have consulted their doctor and obtained information from the manufacturer of the device.
When these products are used in a welding process, the most important hazards are heat, radiation, electric shock and welding fumes.
Heat: Spatter and melting metal can cause burn injuries and start fires.
Radiation: Arc rays can severely damage eyes or skin.
Electricity: Electric shock can kill.
Fumes: Overexposure to welding fumes may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes.
Chronic overexposure to welding fumes may affect pulmonary function. Prolonged inhalation of nickel and chromium compounds above safe exposure limits can cause cancer. Overexposure to manganese and manganese compounds above safe exposure limits can cause irreversible damage to the central nervous system, including the brain, symptoms of which may include slurred speech, lethargy, tremor, muscular weakness, psychological disturbances and spastic gait.
Thorium dioxide is a naturally occurring radioactive material which can emit alpha particles which is the basis of its designation as a carcinogen.
This designation is based upon the use of thorium dioxide in medical procedures. Industrial exposures have not been shown to produce adverse effects.
However, good practice is to avoid the inhalation of dusts and fumes.

Section 2: Hazard(s) Identification *(Continued)*

GHS-US Classification

• STOT RE 1	: H315	• STOT SE 1	: H335	• STOT RE 1	: H372	• Aquatic Acute 1	: H410
• Aquatic Acute 1	: H400						

GHS-US Labelling

GHS07

GHS08

GHS09

Signal Word (GHS-US):	Danger
Hazard Statements (GHS-US):	H317 - May cause an allergic skin reaction H319 - Causes eye irritation H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled H340 - Suspected of causing genetic defects H351 - Suspected of causing cancer H370 - Causes damage to organs (kidneys, respiratory system) H372 - Causes damage to organs through prolonged or repeated exposure H400 - Very toxic to aquatic life H410 - Very toxic to aquatic life with long lasting effects

Precautionary statements (GHS-US):

P201 - Obtain special instructions before use
P202 - Do not handle until all safety precaustions have been read and understood
P260 - Do not breathe dust/fume/gas/mist/vapours/spray
P261 - Avoid breathing dust/fume/gas/mist/vapours/spray
P264 - Wash thoroughly after handling
P270 - Do not eat, drink or smoke when using this product.
P272 - Contaminated work clothing should not be allowed out of the workplace
P273 - Avoid release into the environment
P280 - Wear protective gloves
P284 - In case of inadequate ventilation wear respiratory protection
P308+313 - IF exposed: Call a POISON CENTER or doctor/physician
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes.
Remove contact lenses if present and easy to do – continue rinsing.
If eye irritation persists seek medical advice/attention.
P342+P311 - IF experiencing respiratory symptoms: Call a POISON CENTER and / or doctor / physician.
P302+P352 - IF ON SKIN: Wash with plenty of soap and water
P333+P313 - If skin irritation or rash occurs: Get medical advice / attention
P363 - Wash contaminated clothing before reuse
P308+P311 - IF exposed or concerned: Seek medical advice / attention. Collect spillage.
P402+P404 - Store in a dry place. Store in a closed container.
P501 - Dispose of contents and container in accordance with local regional/national international regulations.

For thoriated tungsten electrodes, store in tightly closed containers in a cool and well-ventilated area.
Nobody should remain permanently or longer than necessary in close proximity to the stored thoriated tungsten electrodes as the electrodes may emit alpha, beta and gamma radiation.
Additional measures should be taken to protect from such possible alpha, beta and gamma radiation.
Thoriated tungsten electrodes may be incompatible with some strong acids.

Warning! - Avoid breathing welding fumes and gases, they may be dangerous to your health. Always use adequate ventilation.
Always use appropriate personal protective equipment.

- **Promary Routes of Entry:** Respiratory System, Eyes and/or Skin.
- **Electrick Shock:** Arc welding and associated processes can kill. See Section 8.

Arc Rays: The welding arc can injure eyes and burn skin.
Fumes and Gases: Can be dangerous to your health.

Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, the process, procedures and electrodes used. Most fume ingredients are present as complex oxides and compounds and not as pure metals. When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 3. Decomposition products of normal operation include those originating from the volatilization, reaction or oxidation of the materials shown in this section, plus those from the base metal and coating, etc., as noted above. Monitor for the materials identified in the list within this section.
Fumes from the use of this product may contain complex oxides or compounds of the following elements and molecules: amorphous silica fume, beryllium, chromium, manganese and nickel. Other reasonably expected constituents of the fume would also include complex oxides of iron and silicon. Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from the arc. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating or galvanizing), the number of welders and the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities).
One recommended way to determine the composition and quantity of fumes and gases to which workers are exposed is to take an air sample inside the welder's helmet if worn or in the **worker's** breathing zone.
See ANSI/AWS F1.1, available from the "American Welding Society", P.O. Box 351040, Miami, FL 33135. Also, from AWS is F1.3 "Evaluating Contaminants in the Welding Environment - A Sampling Strategy Guide", which gives additional advice on sampling.

Section 3: Composition/Information on Ingredients

Hazardous Ingredient	CAS	EINCSr	Hazard Classification (1)	IARC (2)	NTP (3)	OSHA List (4)
Cerium Dioxide	1306-38-3	215-150-4	No	-	-	-
Lanthanum Oxide	1312-81-8	215-200-5	No	-	-	-
Thorium Dioxide	1431-20-1	215-225-1	No	-	-	-
Tungsten	7440-33-7	2311-143-9	No	-	-	-
Zirconium Dioxide	1314-23-4	215-227-2	No	-	-	-

(1) Hazard Classification according to European Council Directive 67/548/EEC, for R-phrases, see Section 16.
(2) Evaluation according to the International Agency for Research on Cancer. / 1 - Carcinogenic to humans. / 2A - Probably carcinogenic to humans. / 2B - Possibly carcinogenic to humans.
(3) Classification according to the 11th Report on Carcinogens, published by the US National Toxicology Program. / K - Known Carcinogen / S - Suspect Carcinogen
(4) Carcinogen listing according to OSHA, Occupational Safety & Health Administration (USA).

Section 3: Composition/Information on Ingredients *(Continued)*

Approximate Composition (%)

Product	Color Code	AWS Classification	Tungsten (W)	Cerium Dioxide (CeO_2)	Lanthanum Oxide (LaO_2)	Thorium Oxide (ThO_2)	Zirconium Oxide (ZrO_2)
Pure	Green	EWP	> 99	-	-	-	-
1% Thoriated	Yellow	EWTh-1	> 98	-	-	0 ~ 2	-
2% Thoriated	Red	EWTh-2	> 97	-	-	1 ~ 2.5	-
Zirconate	Brown	EWEZr	> 99	-	-	-	< 1
2% Ceriated	Orange	EWCe-2	> 97	1 ~ 2.5	-	-	-
1.5% Lanthanated	Gold	EWLa-1.5	> 97	-	1 ~ 2	-	-

Section 4: First Aid Measures

Inhalation: If breathing has stopped, perform artificial respiration and obtain medical assistance immediately! If breathing is difficult, provide fresh air and call physician.
Eye contact: For radiation burns due to arc flash, see physician. To remove dusts or fumes flush with water for at least fifteen minutes.
If irritation persists, obtain medical assistance.
Skin contact: For skin burns from arc radiation, promptly flush with cold water. Get medical attention for burns or irritations that persist.
To remove dust or particles wash with mild soap and water.
Electric shock: Disconnect and turn off the power. Use a nonconductive material to pull victim away from contact with live parts or wires.
If not breathing, begin artificial respiration, preferably mouth-to-mouth. If no detectable pulse, begin Cardio Pulmonary Resuscitation (CPR).
Immediately call a physician.
General: Move to fresh air and call for medical aid.

Section 5: Fire and Explosion Hazard Data

Solid objects may be picked up and placed into a container. Liquids or pastes should be scooped up and placed into a container.
Wear proper protective equipment while handling these materials. Do not discard as refuse.
Personal precautions: refer to Section 8
Environmental precautions: refer to Section 13

Section 6: Accidental Release Measures

Solid objects can be picked up and placed into a container. Wear proper personal protective equipment while handling. Do not discard as general trash.

Section 7: Handling and Storage

Handling:
Handle with care to avoid stings and cuts. Wear gloves when handling welding consumables. Avoid exposure to dust.
Do not ingest. Some individuals can develop an allergic reaction to certain materials. Retain all warning and identity labels.
Storage:
Keep separate from chemical substances like acids and strong bases, which could cause chemical reactions.

Section 8: Exposure Control and Personal Protection

Avoid exposure to welding fumes, radiation, spatter, electric shock, heated materials and dust.
Engineering measures:
Ensure sufficient ventilation, local exhaust, or both, to keep welding fumes and gases from breathing zone and general area. Keep working place and protective clothing clean and dry. Train welders to avoid contact with live electrical parts and insulate conductive parts. Check condition of protective clothing and equipment on a regular basis.
Personal protective equipment:
Use respirator or air supplied respirator when welding or brazing in a confined space, or where local exhaust or ventilation is not sufficient to keep exposure values within safe limits. Use special care when welding painted or coated steels since hazardous substances from the coating may be emitted. Wear hand, head, eyes, ear and body protection like welders gloves, helmet or face shield with filter lens, safety boots, apron, arm and shoulder protection. Keep protective clothing clean and dry.
Use industrial hygiene monitoring equipment to ensure that exposure does not exceed applicable national exposure limits.
The following limits can be used as guidance. For information about welding fume analysis refer to Section 10.

Section 8: Exposure Control and Personal Protection *(Continued)*

Substance	CAS	OSHA PEL	ACGIH TLV
Cerium Dioxide	1306-38-3	-	-
Lanthanum Oxide	1312-81-8	-	-
Thorium Dioxide	1314-20-1	-	-
Tungsten	7440-33-7	-	5, 10 (STEL)
Zirconium Dioxide	1314-23-4	5	5, 10 (STEL)

(1) Threshold Limit Values according to American Conference of Governmental Industrial Hygienists, 2014
(2) Permissible Exposure Limits according to the Occupational Safety & Health Administration (USA)
Unless noted, all values are for 8 hour time weighted averages (TWA).

Section 9: Physical and Chemical Properties

Welding consumables applicable to this sheet as shipped are nonreactive, nonflammable, nonexplosive and essentially nonhazardous until welded.

- **Physical State:** Solid
- **Odor:** N/A
- **Color:** Metallic
- **Form:** Bare Electrode

Section 10: Stability and Reactivity

General: These products are intended for normal welding purposes.
Stability: These products are stable under normal conditions.
Reactivity: Contact with chemical substances like acids or strong bases could cause generation of gas.
When these products are used in a welding process, hazardous decomposition products would include those from the volatilization, reaction or oxidation of the materials listed in Section 3 and those from the base metal and coating.
The amount of fumes generated from these products varies with welding parameters and dimensions but is generally no more than 1 to 10 g/kg consumable. Fumes from these products may contain compounds of the following chemical elements: Fe, O, Mn, Cr, Ni, Si, Mo, Al, Mg, W, Zr, Th, Cs, and La. The rest is not analyzed, according to available standards. Refer to the welding product SDS for additional information on welding fumes.
Refer to applicable national exposure limits for fume compounds, including those exposure limits for fume compounds found in Section 8.
A significant amount of the chromium in the fumes can be hexavalent chromium, which has a very low exposure limit in some countries.
Manganese has a low exposure limit, in some countries that may be easily exceeded.
Reasonably expected gaseous products would include carbon oxides, nitrogen oxides and ozone. Air contaminants around the welding area can be affected by the welding process and influence the composition and quantity of fumes and gases produced.

Section 11: Toxicological Information

Inhalation of welding fumes and gases can be dangerous to your health. Classification of welding fumes is difficult because of varying base materials, coatings, air contamination and processes.
The International Agency for Research on Cancer has classified welding fumes as possibly carcinogenic to humans (Group 2B).
Acute toxicity: Overexposure to welding fumes may result in symptoms like metal fume fever, dizziness, nausea, dryness or irritation of the nose, throat or eyes.
Chronic toxicity: Overexposure to welding fumes may affect pulmonary function. Prolonged inhalation of nickel and chromium compounds above safe exposure limits can cause cancer.
Overexposure to manganese and manganese compounds above safe exposure limits can cause irreversible damage to the central nervous system, including the brain, symptoms of which may include slurred speech, lethargy, tremor, muscular weakness, psychological disturbances and spastic gait.
Thorium dioxide is a naturally occurring radioactive material which can emit alpha particles which is the basis of its designation as a carcinogen.
This designation is based upon the use of thorium dioxide in medical procedures. Industrial exposures have not been shown to produce adverse effects.

Section 12: Ecological Information

Welding processes can release fumes directly to the environment. Welding wire can degrade if left outside and unprotected. Residues from welding consumables and processes could degrade and accumulate in the soil and groundwater.

Section 13: Disposal Considerations

Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal and local regulations. Use recycling procedures if available.
USA RCRA: These products are not considered hazardous waste if discarded.
Residues from welding consumables and processes could degrade and accumulate in soils and groundwater.

Section 14: Transport Information

No international regulations or restrictions are applicable. No special precautions are necessary.

Section 15: Regulatory Information

Read and understand the manufacturer's instructions, your employer's safety practices and the health and safety instructions on the label.
Observe any federal and local regulations. Take precautions when welding and protect yourself and others.
WARNING: Welding fumes and gases are hazardous to your health and may damage lungs and other organs. Use adequate ventilation.
ELECTRIC SHOCK can kill.
ARC RAYS and SPARKS can injure eyes and burn skin.
Wear correct hand, head, eye and body protection.

Canada:	WHMIS classification: Class D; Division 2, Subdivision A Canadian Environmental Protection Act (CEPA): All constituents of these products are on the Domestic Substance List (DSL).
USA:	Under the OSHA Hazard Communication Standard, these products are considered hazardous. These products contain or produce a chemical known to the state of California to cause cancer and birth defects (or other reproductive harm). (California Health & Safety Code § 25249.5 et seq.) United States EPA Toxic Substance Control Act: All constituents of these products are on the TSCA inventory list or are excluded from listing.

CERCLA/SARA TITLE III: Reportable Quantities (RQs) and/or Threshold Planning Quantities (TPQs):

• **Ingredient Name**	**RQ (Lb)**	**TPQ (Lb)**

No ingredients listed in this section.

Spills or releases resulting in the loss of any ingredient at or above its RQ require immediate notification to the National Response Center and to your Local Emergency Planning Committee.

Canadian Environmental Protection Act (CEPA): All constituents of these products are on the Domestic Substance List (DSL).

Section 311 Hazard Class

As shipped: Immediate

In Use: Immediate Delayed

EPCRA/SARA TITLE III 313 Toxic Chemicals: The following metallic components are listed as SARA 313 “Toxic Chemicals” and potentially subject to annual SARA 312 reporting: See Section 3 for weight percent.

No ingredients listed in this section.

Section 16: Other Information

The following Risk and Safety Phrase Texts and Hazard Statements correspond with the columns labeled - EU 67/548/EEC within Section 2 of this safety data sheet.
Take appropriate precautions and protective measures to eliminate or limit the associated hazard.
For additional information please refer to the following sources:

USA: **American National Standard (ANSI) Z49.1** “Safety in Welding and Cutting”, **ANSI/American Welding Society (AWS) F1.5** “Methods for Sampling and Analyzing Gases from Welding and Allied Processes”, **ANSI/AWS F1.1** “Method for Sampling Airborne Particles Generated by Welding and Allied Processes”, **AWSF3.2M/F3.2** “Ventilation Guide for Weld Fume”, American Welding Society, 550 North Le Jeune Road, Miami, Florida, 33135. Safety and Health Fact Sheets available from AWS at www.aws.org. **OSHA Publication 2206 (29 C.F.R. 1910),** U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. **Threshold Limit Values and Biological Exposure Indices**, American Conference of Governmental Hygienists (ACGIH), 6500 Glenway Ave., Cincinnati, Ohio 45211, USA. **NFPA 51B** “Standard for Fire Prevention during Welding, Cutting and Other Hot Work” published by the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169.

UK: **WMA Publication 236 and 237,** “Hazards from Welding Fume”, “The arc welder at work, some general aspects of health and safety”.

Canada: **CSA Standard CAN/CSA-W117.2-01** “Safety in Welding, Cutting and Allied Processes”.

Liability-Disclaimer: American Filler Metals *does not assume liability whatsoever for the accuracy or completeness of the information contained in this SDS. The information contained is accurate to the best of our knowledge. The final suitability of any material is the responsibility of the user. Materials may present unknown hazards and are intended for use by qualified individuals experienced and trained in welding safety.*

SAFETY DATA SHEET

Argon

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Argon

Chemical name : Argon

Other means of identification : Argon-40; Argon, isotope of mass 40; 40Ar; ARGON; Argon,Welding Quality; ARGON, COMPRESSED

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : Argon-40; Argon, isotope of mass 40; 40Ar; ARGON; Argon,Welding Quality; ARGON, COMPRESSED

SDS # : 001004

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas
SIMPLE ASPHYXIANTS

GHS label elements

Hazard pictograms :

Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Not applicable.

Response : Not applicable.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Supplemental label elements : Keep container tightly closed. Use only with adequate ventilation. Do not enter storage areas and confined spaces unless adequately ventilated.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : Argon

Other means of identification : Argon-40; Argon, isotope of mass 40; 40Ar; ARGON; Argon,Welding Quality; ARGON, COMPRESSED

Product code : 001004

CAS number/other identifiers

CAS number : 7440-37-1

Ingredient name	%	CAS number
Argon	100	7440-37-1

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards. Acts as a simple asphyxiant.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Hazardous thermal decomposition products : No specific data.

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Section 7. Handling and storage

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Argon	**ACGIH TLV (United States, 3/2017). Oxygen Depletion [Asphyxiant].**

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Section 8. Exposure controls/personal protection

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : The gas can cause asphyxiation without warning by replacing the oxygen in the air. Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. If operating conditions cause high gas concentrations to be produced or any recommended or statutory exposure limit is exceeded, use an air-fed respirator or self-contained breathing apparatus. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas.

Color : Colorless.

Odor : Odorless.

Odor threshold : Not available.

pH : Not available.

Melting point : -189.2°C (-308.6°F)

Boiling point : -185.9°C (-302.6°F)

Critical temperature : -122.4°C (-188.3°F)

Flash point : [Product does not sustain combustion.]

Evaporation rate : Not available.

Flammability (solid, gas) : Not available.

Lower and upper explosive (flammable) limits : Not available.

Vapor pressure : Not available.

Vapor density : 1.66 (Air = 1)

Specific Volume (ft^3/lb) : 9.7087

Gas Density (lb/ft^3) : 0.103

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : Not available.

Partition coefficient: n-octanol/water : 0.74

Auto-ignition temperature : Not available.

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 39.95 g/mole

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Do not allow gas to accumulate in low or confined areas.

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards. Acts as a simple asphyxiant.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Section 11. Toxicological information

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Argon	0.74	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1006	UN1006	UN1006	UN1006	UN1006
UN proper shipping name	ARGON, COMPRESSED	ARGON, COMPRESSED	ARGON, COMPRESSED	ARGON, COMPRESSED	ARGON, COMPRESSED
Transport hazard class(es)	2.2	2.2	2.2	2.2	2.2
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Limited quantity**
No

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
Passenger Carrying Road or Rail Index 75
Special provisions 42

IATA : Limited quantity
No

Passenger and Cargo Aircraft Quantity limitation: Forbidden

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: This material is listed or exempted.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: Not determined.
Japan inventory (ISHL): Not determined.

Malaysia : Not determined.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Section 15. Regulatory information

Taiwan : This material is listed or exempted.

Thailand : Not determined.

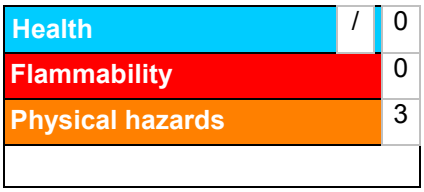
Turkey : Not determined.

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
GASES UNDER PRESSURE - Compressed gas SIMPLE ASPHYXIANTS	Expert judgment Expert judgment

History

Date of printing : 4/11/2019

Date of issue/Date of revision : 4/11/2019

Date of previous issue : 4/11/2019

Version : 1.03

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973

Section 16. Other information

as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET
Klean Strip Denatured Alcohol

Printed: 04/13/2015
Revision: 04/13/2015
Supersedes Revision: 09/10/2014

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Klean Strip Denatured Alcohol

Company Name: W. M. Barr
2105 Channel Avenue
Memphis, TN 38113

Phone Number: (901)775-0100

Web site address: www.wmbarr.com

Emergency Contact: 3E 24 Hour Emergency Contact (800)451-8346
Information: W.M. Barr Customer Service (800)398-3892

Intended Use: Cleans glass and is used as a fuel for marine stoves

Synonyms: CSL26, GSL26, QSL26, QSL26W

Additional Information This product is regulated by the United States Consumer Product Safety Commission and is subject to certain labeling requirements under the Federal Hazardous Substances Act. These requirements differ from the classification criteria and hazard information required for safety data sheets (SDS). The product label also includes other important information, including directions for use, and should always be read in its entirety prior to using the product.

2. HAZARDS IDENTIFICATION

Flammable Liquids, Category 2
Acute Toxicity: Oral, Category 3
Acute Toxicity: Skin, Category 3
Acute Toxicity: Inhalation, Category 3
Specific Target Organ Toxicity (single exposure), Category 1

GHS Signal Word: **Danger**

GHS Hazard Phrases:
H225: Highly flammable liquid and vapor.
H301: Toxic if swallowed.
H311: Toxic in contact with skin.
H331: Toxic if inhaled.
H370: Causes damage to organs.

GHS Precaution Phrases:
P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P233: Keep container tightly closed.
P240: Ground/bond container and receiving equipment.
P241: Use explosion-proof electrical/ventilating/lighting equipment.
P242: Use only non-sparking tools.
P243: Take precautionary measures against static discharge.
P260: Do not breathe gas/mist/vapors/spray.
P264: Wash hands thoroughly after handling.
P270: Do not eat, drink or smoke when using this product.
P271: Use only outdoors or in a well-ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P235: Keep cool.

GHS Response Phrases:
P301+310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P302+352: IF ON SKIN: Wash with plenty of soap and water.
P303+361+353: IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

P307+311: IF exposed: Call a POISON CENTER or doctor/physician.
P311: Call a POISON CENTER or doctor/physician.
P330: Rinse mouth.
P361: Remove/Take off immediately all contaminated clothing.
P363: Wash contaminated clothing before reuse.
P370+378: In case of fire, use dry chemical powder to extinguish.

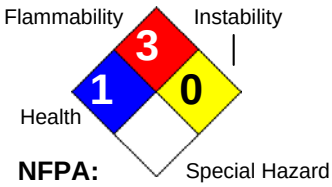
GHS Storage and Disposal Phrases:
P403+233: Store container tightly closed in well-ventilated place.
P405: Store locked up.
P501: Dispose of contents/container to local, state and federal regulations.

Hazard Rating System:

HMIS:

HEALTH	*	2
FLAMMABILITY		3
PHYSICAL		0
PPE		X

NFPA:



OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.

Potential Health Effects (Acute and Chronic):

Inhalation Acute Exposure Effects:
Vapor harmful. May cause dizziness, headache, watering of eyes, irritation of respiratory tract, irritation to the eyes, drowsiness, nausea, other central nervous system effects, spotted or blurry vision, dilation of pupils, and convulsions.

Skin Contact Acute Exposure Effects:
May cause irritation, drying of skin, redness, and dermatitis. May cause symptoms listed under inhalation. May be absorbed through damaged skin.

Eye Contact Acute Exposure Effects:
May cause irritation.

Ingestion Acute Exposure Effects:
Poison. Cannot be made non-poisonous. May be fatal or cause blindness. May produce fluid in the lungs and pulmonary edema. May cause dizziness, headache, nausea, drowsiness, loss of coordination, stupor, reddening of face and or neck, liver, kidney and heart damage, coma, and death. May produce symptoms listed under inhalation.

Chronic Exposure Effects:
May cause symptoms listed under inhalation, dizziness, fatigue, tremors, permanent central nervous system changes, blindness, pancreatic damage, and death.

Target Organs:
Liver, kidneys, pancreas, heart, lungs, brain, central nervous system, eyes

Medical Conditions Generally Aggravated By Exposure: Diseases of the liver, skin, lung, kidney, central nervous system, pancreas, and heart; asthma; inflammatory or fibrotic pulmonary disease; any preexisting condition sensitive to a decrease in available oxygen, such as chronic lung disease, coronary artery disease, or anemias

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS #	Hazardous Components (Chemical Name)	Concentration	RTECS #
64-17-5	Ethyl alcohol {Ethanol}	30.0 -50.0 %	KQ6300000
67-56-1	Methanol {Methyl alcohol; Carbinol; Wood alcohol}	40.0 -60.0 %	PC1400000

Additional Chemical Information Specific percentage of composition is being withheld as a trade secret.

4. FIRST AID MEASURES

Emergency and First Aid Procedures:

Skin:
Immediately begin washing the skin thoroughly with large amounts of water and mild soap, if available, while removing contaminated clothing. Seek medical attention if irritation persists.

Eyes:
Immediately begin to flush eyes with water, remove any contact lens. Continue to flush the eyes for at least 15 minutes, then seek immediate medical attention.

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get immediate medical attention.

Ingestion:
If swallowed, do NOT induce vomiting. Seek immediate medical attention. Call a physician, hospital emergency room, or poison control center immediately. Never give anything by mouth to an unconscious person.

Signs and Symptoms Of Exposure: See Potential Health Affects

Note to Physician: Poison. This product contains methanol. Methanol is metabolized to formaldehyde and formic acid. These metabolites may cause metabolic acidosis, visual disturbances and blindness. Since metabolism is required for these toxic symptoms, their onset may be delayed from 6 to 30 hours following ingestion. Ethanol competes for the same metabolic pathway and has been used as an antidote. Methanol is effectively removed by hemodialysis. Call your local poison control center for further instructions.

5. FIRE FIGHTING MEASURES

OSHA Class IB

Flash Pt: 45.00 F Method Used: Setaflash Closed Cup (Rapid Setaflash)

Explosive Limits: LEL: No data. UEL: No data.

Autoignition Pt: No data.

Suitable Extinguishing Media: Use carbon dioxide, dry powder, or alcohol resistant foam.

Unsuitable Extinguishing Media: Water may be ineffective. Solid streams of water will likely spread the fire.

Fire Fighting Instructions: Self-contained respiratory protection should be provided for fire fighters fighting fires in buildings or confined area. Storage containers exposed to fire should be kept cool with water spray to prevent pressure build-up. Stay away from heads of containers that have been exposed to intense heat or flame.

Flammable Properties and Hazards: Vapors are heavier than air. Vapor may travel considerable distance to source of ignition and flash back.

Flammability Classification:

6. ACCIDENTAL RELEASE MEASURES

Steps To Be Taken In Case Material Is Released Or Spilled:

Vapors are heavier than air. Vapors may cause flash fire or ignite explosively.

Clean up: Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Shut off ignition sources; keep flares, smoking or flames out of hazard area. Use non-sparking tools. Use proper bonding and grounding methods for all equipment and processes. Keep out of waterways and bodies of water. Be cautious of vapors collecting in small enclosed spaces, sewers, low lying areas, confined spaces, etc.

Small spills: Take up with sand, earth or other noncombustible absorbent material and place in a plastic container where applicable.

Large spills: Dike far ahead of spill for later disposal.

Waste Disposal: Dispose in accordance with applicable local, state and federal regulations.

7. HANDLING AND STORAGE

Precautions To Be Taken in Handling:

Read carefully all cautions and directions on product label before use. Since empty container retains residue, follow all label warnings even after container is empty. Dispose of empty container according to all regulations. Do not reuse this container.

Do not use this product near any source of heat or open flame, furnace areas, pilot lights, stoves, etc.

Do not use in small enclosed spaces, such as basements and bathrooms where vapors can accumulate. Vapors can accumulate and explode if ignited.

Do not use this product if the work area is not well ventilated. Use only with adequate ventilation to prevent build up of vapors.

Do not spread this product over large surface areas because fire and health safety risks will increase dramatically.

Use proper bonding and grounding when transferring material. Be aware of static electricity generation when handling material.

Precautions To Be Taken in Storing:

Keep container tightly closed when not in use. Store in a cool, dry place. Do not store near any source of heat or open flame, furnace areas, pilot lights, stoves, etc.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

CAS #	Partial Chemical Name	OSHA TWA	ACGIH TWA	Other Limits
64-17-5	Ethyl alcohol {Ethanol}	PEL: 1000 ppm	TLV: 1000 ppm	No data.
67-56-1	Methanol {Methyl alcohol; Carbinol; Wood alcohol}	PEL: 200 ppm	TLV: 200 ppm STEL: 250 ppm	No data.

Respiratory Equipment (Specify Type): For use in areas with inadequate ventilation or fresh air, wear a properly maintained and properly fitted NIOSH approved respirator for organic solvent vapors.

For OSHA controlled work places and other regular users - Use only with adequate ventilation under engineered air control systems designed to prevent exceeding the appropriate TLV.

A dust mask does not provide protection against vapors.

Eye Protection: Chemical splash goggles should be worn to prevent eye contact.

Protective Gloves: Wear gloves with as much resistance to the chemical ingredients as possible. Glove materials such as nitrile, natural rubber, and neoprene will provide protection. Glove selection should be based on chemicals being used and conditions of use. Consult your glove supplier for additional information. Gloves contaminated with product should be discarded and not reused.

Other Protective Clothing: Various application methods can dictate the use of additional protective safety equipment, such as impermeable aprons, etc., to minimize exposure.

Engineering Controls (Ventilation etc.): Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Use only with adequate ventilation to prevent buildup of vapors. Do not use in areas where vapors can accumulate and concentrate, such as basements, bathrooms or small enclosed areas. Whenever possible, use outdoors in an open air area. If using indoors open all windows and doors and maintain a cross ventilation of moving fresh air across the work area. If strong odor is noticed or you experience slight dizziness, headache, nausea or eye-watering -- STOP -- ventilation is inadequate. Leave area immediately and move to fresh air.

Work/Hygienic/Maintenance Practices: Wash hands thoroughly after use and before eating, drinking, smoking, or using the restroom.

Do not eat, drink, or smoke in the work area.

Discard any clothing or other protective equipment that cannot be decontaminated.

Facilities storing or handling this material should be equipped with an emergency eyewash and safety shower.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical States:	[ ] Gas [X] Liquid [ ] Solid
Appearance and Odor:	Water white, alcohol odor
Melting Point:	No data.
Boiling Point:	147.00 F
Autoignition Pt:	No data.
Flash Pt:	45.00 F Method Used: Setaflash Closed Cup (Rapid Setaflash)
Explosive Limits:	LEL: No data. UEL: No data.
Specific Gravity (Water = 1):	0.7934 - 0.8108
Density:	6.646 LB/GL
Vapor Pressure (vs. Air or mm Hg):	76 MM HG at 68.0 F
Vapor Density (vs. Air = 1):	> 1
Evaporation Rate:	> 1
Solubility in Water:	No data.
Percent Volatile:	100.0 % by weight.
VOC / Volume:	793.0000 G/L

10. STABILITY AND REACTIVITY

Stability:	Unstable [ ] Stable [X]
Conditions To Avoid - Instability:	No data available.
Incompatibility - Materials To Avoid:	Incompatible with strong oxidizing agents, strong acids, reactive metals, halogens, strong inorganic acids, and aldehydes.
Hazardous Decomposition Or Byproducts:	Decomposition may produce carbon monoxide and carbon dioxide.
Possibility of Hazardous Reactions:	Will occur [ ] Will not occur [X]
Conditions To Avoid - Hazardous Reactions:	No data available.

11. TOXICOLOGICAL INFORMATION

Toxicological Information: This product has not been tested as a whole. Refer to section 2 for acute and chronic effects.

Carcinogenicity/Other Information:
IARC 1 - Carcinogenic to Humans
IARC 2B - Possibly Carcinogenic to Humans
ACGIH A4 - Not Classifiable as a Human Carcinogen.

IARC has determined that the consumption of alcoholic beverages is casually related to the occurrence of malignant tumors of the oral cavity, pharynx, larynx, esophagus, and liver in humans. The carcinogenic response attributed to drinking alcoholic beverages has not be verified in studies with laboratory animals. Established uses of denatured ethanol and non-beverage use of pure ethanol are not considered to pose any significant cancer hazard.

CAS #	Hazardous Components (Chemical Name)	NTP	IARC	ACGIH	OSHA
64-17-5	Ethyl alcohol {Ethanol}	n.a.	1	A4	n.a.
67-56-1	Methanol {Methyl alcohol; Carbinol; Wood alcohol}	n.a.	n.a.	n.a.	n.a.

12. ECOLOGICAL INFORMATION

General Ecological Information: This product has not been tested as a whole.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method: Dispose in accordance with applicable local, state, and federal regulations.

14. TRANSPORT INFORMATION

LAND TRANSPORT (US DOT):

DOT Proper Shipping Name: Alcohols, n.o.s. (Ethyl Alcohol, Methanol)
DOT Hazard Class: 3 FLAMMABLE LIQUID
UN/NA Number: UN1987 **Packing Group:** II

Additional Transport Information: The shipper / supplier may apply one of the following exceptions: Combustible Liquid, Consumer Commodity, Limited Quantity, Viscous Liquid, Does Not Sustain Combustion, or others, as allowed under 49CFR Hazmat Regulations. Please consult 49CFR Subchapter C to ensure that subsequent shipments comply with these exceptions.

15. REGULATORY INFORMATION

EPA SARA (Superfund Amendments and Reauthorization Act of 1986) Lists

CAS #	Hazardous Components (Chemical Name)	S. 302 (EHS)	S. 304 RQ	S. 313 (TRI)
64-17-5	Ethyl alcohol {Ethanol}	No	No	No
67-56-1	Methanol {Methyl alcohol; Carbinol; Wood alcohol}	No	Yes 5000 LB	Yes

This material meets the EPA 'Hazard Categories' defined for SARA Title III Sections 311/312 as indicated:	[X] Yes [ ] No	Acute (immediate) Health Hazard
	[X] Yes [ ] No	Chronic (delayed) Health Hazard
	[X] Yes [ ] No	Fire Hazard
	[ ] Yes [X] No	Sudden Release of Pressure Hazard
	[ ] Yes [X] No	Reactive Hazard

CAS #	Hazardous Components (Chemical Name)	Other US EPA or State Lists
64-17-5	Ethyl alcohol {Ethanol}	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No
67-56-1	Methanol {Methyl alcohol; Carbinol; Wood alcohol}	CAA HAP,ODC: HAP; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: Yes

Regulatory Information Statement:	All components of this material are listed on the TSCA Inventory or are exempt.

16. OTHER INFORMATION

Revision Date:	04/13/2015
Preparer Name:	W.M. Barr EHS Dept (901)775-0100
Additional Information About This Product:	No data available.
Company Policy or Disclaimer:	The information contained herein is presented in good faith and believed to be accurate as of the effective date shown above. This information is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determination of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees. Any use of this data and information must be determined by the user to be in accordance with applicable federal, state and local laws and regulations.

Copper

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Copper - shot, sheet, foil, rod, wire, pellets, target

Formula: Cu

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Not classified as hazardous

GHS Label Elements:

Signal Word: N/A

Hazard Statements: N/A

Precautionary Statements: N/A

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient: Copper

CAS#: 7440-50-8

%: >99

EC#: 231-159-6

4 FIRST AID MEASURES

General Measures: No special requirements.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek medical

Need Help?

Available Mon-Fri 8am to 5pm Pacific Time

Contact

ESPI Metals
1050 Benson Way
Ashland, Oregon 97520

541.488.8311 telephone
800.638.2581 toll-free

541.488.8313 fax
800.488.0060 toll-free fax

sales@espimetals.com

Your Feedback Matters

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attention.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, brush material off skin, wash affected area with soap and water. Seek medical attention if symptoms persist.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention if symptoms persist.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other relevant information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use suitable extinguishing media for surrounding material and type of fire. Use Class D or other metal extinguishing agent for fires involving fines, dusts or molten metals.

Unsuitable Extinguishing Media: Do not use halogenated extinguishers on small chips or fines. Do not use water in fighting fires around molten metal.

Specific Hazards Arising from the Material: May emit copper oxide fumes under fire conditions.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8.

Methods and Materials for Containment and Cleaning Up: Sweep or scoop up. Place in properly labeled closed containers. Scrap can be collected for recycling.

Environmental Precautions: Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Avoid creating dust. Avoid breathing dust or fumes. Provide adequate ventilation if dusts are created. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking. See section 8 for information on personal protection equipment.

Conditions for Safe Storage: Store in a sealed container. Store in a cool, dry area. Protect from air and moisture. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: Copper

OSHA/PEL: 0.1 mg/m^3

ACGIH/TLV: 0.2 mg/m^3

Engineering Controls: Ensure adequate ventilation to maintain exposures below occupational limits. Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air.

Respiratory Protection: If permissible levels are exceeded, use NIOSH approved dust respirator.

Eye Protection: Safety glasses

Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

Precious Metal Prices

Nov 04,2019 at 15:05 New York		Price	Change	High
Gold	▼	1507.90	-6.20	1515.50
Silver	▼	18.02	-0.06	18.30
Platinum	▼	933.00	-15.00	958.00
Palladium	▼	1761.00	-31.00	1832.00

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9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Solid in various forms

Color: Reddish metallic

Odor: Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: 1083.4 ^{O}C

Boiling Point: 2567 ^{O}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: N/A

Upper Flammable Limit: N/A

Lower Flammable Limit: N/A

Vapor Pressure: 1 mm Hg @ 1628 ^{O}C

Vapor Density: N/A

Relative Density (Specific Gravity): 8.92 g/cc

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: None expected.

Conditions to Avoid: Avoid creating or accumulating fines or dusts.

Incompatible Materials: Acids, halogens, alkalis, water/moisture.

Hazardous Decomposition Products: Copper oxide fume.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin and eyes.

Symptoms of Exposure: May cause irritation.

Acute and Chronic Effects: Copper is a trace element that is essential for human health. Chronic exposure to copper dust can irritate the respiratory tract, nose, mouth and eyes, and cause headaches, dizziness, nausea and diarrhea. Ingestion of excessive amounts of copper may cause gastrointestinal distress. Chronic ingestion may damage the liver and kidneys.

Acute Toxicity: No data

Carcinogenicity: **NTP**: Not identified as carcinogenic **IARC**: Not identified as carcinogenic

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

Shipping Regulations: Not regulated

UN Number: N/A

UN Proper Shipping Name: N/A

Transport Hazard Class: N/A

Packing Group: N/A

Marine Pollutant: No

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): N/A

Canada WHMIS Classification (CPR, SOR/88-66): N/A

HMIS Ratings: **Health**: 0 **Flammability**: 0 **Physical**: 0

NFPA Ratings: **Health**: 0 **Flammability**: 0 **Instability**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER INFORMATION

The information contained in this document is based on the state of our knowledge at the time of publication and is believed to be correct, but does not purport to be all inclusive and shall be used only as a guide. ESPI Metals makes no representation, warranty, or guarantee of any kind with respect to the information contained in this document or any use of the product based on this information. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product. Users should satisfy themselves that they have all current data relevant to their particular use.

Prepared by: ESPI Metals

Revised/Reviewed: July 2015

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RADNOR®

SAFETY DATA SHEET

This Safety Data Sheet (SDS) is for welding consumables and related products and may be used to comply with OSHA's Hazard Communication standard, 29 CFR 1910.1200, and Superfund Amendments and Reauthorization Act (SARA) of 1986 Public Law 99-499 and Canadian Workplace Hazardous Materials Information System (WHMIS) per Health Canada administrative policy. The OSHA standard must be consulted for specific requirements. This Safety Data Sheet complies with ISO 11014-1 and ANSI Z400.1. This document is translated in several languages and is available on our website at www.hobartbrothers.com, from your sales representative or by calling customer service at 1 (937) 332-4000.

SECTION 1 – IDENTIFICATION

Manufacturer/Supplier
Name: HOBART BROTHERS COMPANY — Telephone No: +1 (937) 332-4000
Address: 101 TRADE SQUARE EAST, TROY, OH 45373 — Emergency No: +1 (800) 424-9300
Website: www.hobartbrothers.com

Products Type: GAS METAL ARC WELDING (GMAW) STAINLESS WIRE AND GAS TUNGSTEN ARC WELDING (GTAW) STAINLESS WIRE

Trade Name: 308, 308H, 308L, 308L HiSil, 309, 309(H), 309L, 309L HiSil, 310,316, ER316L, ER316L HiSil, 347, 410, 410NiMo, 317L, 630, 312, 2209

AWS Specification: A5.9 - ER308, ER308H, ER308L, ER308LSi, ER309, ER309(H), ER309L, ER309LSi, ER 310, ER316, ER316L, ER316LSi, ER347, ER410, ER410NiMo, ER317L, ER630, ER312, ER2209

Recommended Use: GAS METAL ARC WELDING (GMAW) STAINLESS WIRE AND GAS TUNGSTEN ARC WELDING (GTAW) STAINLESS WIRE
Restrictions on Use: Use only as indicated for welding operations.

SECTION 2 – IDENTIFICATION OF HAZARDS

HAZARD CLASSIFICATION – The products described in Section 1 is not classified as hazardous according to applicable GHS hazard classification criteria as required and defined in OSHA Hazard Communication Standard (29 CFR Part 1910.1200).

LABEL ELEMENTS: **Hazard Symbol** – No symbol required — **Signal Word** – No signal word required
Hazard Statement – Not applicable — **Precautionary Statement** – Not Applicable

HAZARDS NOT OTHERWISE CLASSIFIED

WARNING! - Avoid breathing welding fumes and gases, they may be dangerous to your health. Always use adequate ventilation. Always use appropriate personal protective equipment.
PRIMARY ROUTES OF ENTRY: Respiratory System, Eyes and/or Skin.
ELECTRIC SHOCK: Arc welding and associated processes can kill. See Section 8.
ARC RAYS: The welding arc can injure eyes and burn skin.
FUMES AND GASES: Can be dangerous to your health.

Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, the process, procedures and electrodes used. Most fume ingredients are present as complex oxides and compounds and not as pure metals. When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 3. Decomposition products of normal operation include those originating from the volatilization, reaction or oxidation of the materials shown in Section 3 of this Safety Data Sheet, plus those from the welding flux, the base metal and any coatings, etc. Monitor for the component materials identified in the list in Section 3.

Fumes from the use of this product may contain complex oxides or compounds of the following elements and molecules: amorphous silica fume, chromium, copper, manganese and nickel. Other reasonably expected constituents of the fume would also include complex oxides of iron, silicon and molybdenum. Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from the arc. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating or galvanizing), the number of welders and the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities). One recommended way to determine the composition and quantity of fumes and gases to which workers are exposed is to take an air sample inside the welder's helmet if worn or in the worker's breathing zone. See ANSI/AWS F1.1 and F1.3, available from the "American Welding Society", 8669 NW 36 Street, # 130, Miami, Florida 33166-6672, Phone: 800-443-9353 or 305-443-9353. Also, from AWS is F1.3 "Evaluating Contaminants in the Welding Environment - A Sampling Strategy Guide", which gives additional advice on sampling.

SECTION 3 – COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS

IMPORTANT - This section covers the hazardous materials from which this product is manufactured. This data has been classified according to the criteria of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) as required and defined in OSHA Hazard Communication Standard (29 CFR Part 1910.1200). The fumes and gases produced during welding with normal use of this product are addressed in Section 8.

INGREDIENT	CAS NO.	EINECS[r]	%WEIGHT	GHS Classification(s)	GHS HAZARD STATEMENTS (See Section 16 for Complete Phrases)
CHROMIUM (metal)	7440-47-3	231-157-5	5-35	**NONE**	
COPPER	7440-50-8	231-159-6	0-4[(1)]	**NONE**	
IRON	7439-89-6	231-096-4	40-90	**NONE**	
MANGANESE	7439-96-5	231-105-1	0-5	**- Acute Tox. 4 (Inhalation)[(2)] - Acute Tox. 4 (Oral)[(2)] - STOT RE 1[(3)]**	**H332 H302 H372**
MOLYBDENUM	7439-98-7	231-107-2	0-4	**- STOT RE 2[(3)] - Eye Irrit. 2[(4)] - STOT SE 3[(5)]**	**H373 H319 H335**
NICKEL	7440-02-0	231-111-4	0-40	**Powder/Element: - Carc. 2[(6)] - Skin Sens. 1[(7)] - STOT RE 1[(3)] - Aquatic Chronic 3**	** H351 H317 H372 H412**

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INGREDIENT	CAS NO.	EINECS[Γ]	%WEIGHT	GHS Classification(s)	GHS HAZARD STATEMENTS (See Section 16 for Complete Phrases)
NIOBIUM	7440-03-1	231-113-5	0-1[(8)]	**NONE**	
(Amorphous Silica Fume)	69012-64-2	273-761-1	---	**NONE**	
SILICON	7440-21-3	231-130-8	<1	**NONE**	
HEXAVALENT CHROMIUM [CHROMIUM (VI) TRIOXIDE] (Fume constituent)	1333-82-0	215-607-8	Varies	**- Ox. Sol. 1[(9)]** **- Carc. 1A[(6)]** **- Muta. 1B[(10)]** **- Repr. Tox. 2[(11)]** **- Acute Tox. 2 (Inhalation)[(2)]** **- Acute Tox. 3 (Skin & Oral)[(2)]** **- STOT RE 1[(3)]** **- Skin Corr. 1A[(12)]** **- Skin Sens. 1[(7)]** **- Resp. Sens. 1[(13)]** **- Aquatic Acute 1** **- Aquatic Chronic 1**	**H271** **H350** **H340** **H361f** **H330** **H311, H301** **H372** **H314** **H317** **H334, H317** **H400** **H410**

Γ – European Inventory of Existing Commercial Chemical Substances Number --- Dashes indicate the ingredient is not present within the group of products **(1)** Present only in ER630 **(2)** Acute toxicity (Cat. 1, 2, 3 and 4) **(3)** Specific target organ toxicity (STOT) – repeated exposure (Cat. 1 and 2)) **(4)** Serious eye damage/eye irritation (Cat. 1 and 2) **(5)** Specific target organ toxicity (STOT) – single exposure ((Cat. 1, 2) and Cat. 3 for narcotic effects and respiratory tract irritation, only**) (6)** Carcinogenicity (Cat. 1A, 1B and 2) **(7)** Skin sensitization (Cat. 1, Sub-cat. 1A and 1B) **(8)** Present only in ER347 and ER630 **(9)** Oxidizing solid (Cat. 1, 2 and 3) **(10)** Germ cell mutagenicity (Cat. 1A, 1B and 2) (**11)** Reproductive toxicity (Cat. 1A, 1B and 2) **(12)** Skin corrosion/irritation (Cat 1, 1A, 1B, 1C and 2) **(13)** Respiratory sensitization (Cat. 1, Sub-cat. 1A and 1B)
--- Dashes indicate the ingredient is not present within the group of products

SECTION 4 – FIRST AID MEASURES

INGESTION: Not an expected route of exposure. Do not eat, drink, or smoke while welding; wash hands thoroughly before performing these activities. If symptoms develop, seek medical attention at once.
INHALATION during welding: If breathing is difficult, provide fresh air and contact physician. If breathing has stopped, perform artificial respiration and obtain medical assistance at once.
SKIN CONTACT during welding: Remove contaminated clothing and wash the skin thoroughly with soap and water. If symptoms develop, seek medical attention at once.
EYE CONTACT during welding: Dust or fume from this product should be flushed from the eyes with copious amounts of clean, tepid water until victim is transported to an emergency medical facility. Do not allow victim to rub or keep eyes tightly closed. Obtain medical assistance at once.
Arc rays can injure eyes. If exposed to arc rays, move victim to dark room, remove contact lenses as necessary for treatment, cover eyes with a padded dressing and rest. Obtain medical assistance if symptoms persist.

Section 11 of this SDS covers the acute effects of overexposure to the various ingredients within the welding consumable. Section 8 of this SDS lists the exposure limits and covers methods for protecting yourself and your co-workers.

SECTION 5 – FIRE-FIGHTING MEASURES

Fire Hazards: Welding consumables applicable to this sheet as shipped are nonreactive, nonflammable, non-explosive and essentially nonhazardous until welded.

Welding arcs and sparks can ignite combustibles and flammable products. If there are flammable materials, including fuel or hydraulic lines, in the work area and the worker cannot move the work or the flammable material, a fire-resistant shield such as a piece of sheet metal or fire resistant blanket should be placed over the flammable material. If welding work is conducted within 35 feet or so of flammable materials, station a responsible person in the work zone to act as fire watcher to observe where sparks are flying and to grab an extinguisher or sound the alarm if needed.
Unused welding consumables may remain hot for a period of time after completion of a welding process. See American National Standard Institute (ANSI) Z49.1 for further general safety information on the use and handling of welding consumables and associated procedures.
Suitable Extinguishing Media: This product is essentially nonflammable until welded; therefore, use a suitable extinguishing agent for a surrounding fire
Unsuitable Extinguishing Media: None known.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

In the case of a release of solid welding consumable products, solid objects can be picked up and placed into a disposal container. If airborne dust and/or fume is present, use adequate engineering controls and, if needed, personal protection to prevent overexposure. Refer to recommendations in Section 8. Wear proper personal protective equipment while handling. Do not discard as general trash.

SECTION 7 - HANDLING AND STORAGE

HANDLING: No specific requirements in the form supplied. Handle with care to avoid cuts. Wear gloves when handling welding consumables. Avoid exposure to dust. Do not ingest. Some individuals can develop an allergic reaction to certain materials. Retain all warning and product labels.
STORAGE: Keep separate from acids and strong bases to prevent possible chemical reactions.

SECTION 8 - EXPOSURE CONTROLS AND PERSONAL PROTECTION

Read and understand the instructions and the labels on the packaging. Welding fumes do not have a specific OSHA PEL (Permissible Exposure Limit) or ACGIH TLV (Threshold Limit Value). The OSHA PEL for Particulates – Not Otherwise Regulated (PNOR) is 5 mg/m3 – Respirable Fraction, 15 mg/m3 – Total Dust. The ACGIH TLV for Particles – Not Otherwise Specified (PNOS) is 3 mg/m3 – Respirable Particles, 10 mg/m3 – Inhalable Particles. The individual complex compounds within the fume may have a lower OSHA PEL or ACGIH TLV than the OSHA PNOR and ACGIH PNOS. An Industrial Hygienist, the OSHA PELs for Air Contaminants (29 CFR 1910.1000), and the ACGIH TLVs should be consulted to determine the specific fume constituents present and their respective exposure limits. All exposure limits are in milligrams per cubic meter (mg/m3).

INGREDIENT	CAS	EINECS	OSHA PEL	ACGIH TLV
CHROMIUM#	7440-47-3	231-157-5	1 (Metal)	0.5 (Metal) {A4}
			0.5 (Cr II & Cr III Cpnds)	0.5 (Cr III Cpnds) {A4}
			0.005 (Cr VI Cpnds, (Calif. OSHA PEL)	0.05 (Cr VI Sol Cpnds) {A1}
				0.01 (Cr VI Insol Cpnds) {A1}
COPPER	7440-50-8	231-159-6	0.1 (Fume), 1 (Dust)	0.2 (Fume), 1 (Dust)
IRON+	7439-89-6	231-096-4	5 R*	5 R* (Fe_2O_3) {A4}
IRON OXIDE	1309-37-1	215-168-2	10 (Oxide Fume)	5 R* (Fe_2O_3) {A4}

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MANGANESE#	7439-96-5	231-105-1	5 CL ** (Fume) 1, 3 STEL*** ■	0.1 I* {A4} ♦ 0.02 R* ♦♦
MOLYBDENUM	7439-98-7	231-107-2	5 R*	3 R*; 10 I* (Ele and Insol) 0.5 R* (Sol Cpnds) {A3}
NICKEL#	7440-02-0	231-111-4	1 (Metal) 1 (Sol Cpnds) 1 (Insol Cpnds)	1.5 I* (Ele) {A5} 0.1 I* (Sol Cpnds) {A4} 0.2 I* (Insol Cpnds) {A1}
NIOBIUM	7440-03-1	231-113-5	Not Established	Not Established
SILICA++	14808-60-7	238-878-4	0.1 R*	0.025 R* {A2}
(Amorphous Silica Fume)	69012-64-2	273-761-1	0.8	2 R*
SILICON+	7440-21-3	231-130-8	5 R*	3 R*

R* - Respirable Fraction I* - Inhalable Fraction ** - Ceiling Limit *** - Short Term Exposure Limit + - As a nuisance particulate covered under "Particulates Not Otherwise Regulated" by OSHA or "Particulates Not Otherwise Classified" by ACGIH #- Reportable material under Section 313 of SARA ■ - NIOSH REL TWA and STEL ■■ - AIHA Ceiling Limit of 1 mg/m^3 ♦ - Limit of 0.1 mg/m^3 is for Inhalable Mn in 2013 by ACGIH ♦♦ - Limit of 0.02 mg/m^3 is for Respirable Mn in 2013 by ACGIH Ele – Element Sol – Soluble Insol – Insoluble Inorg – Inorganic Cpnds – Compounds {A1} - Confirmed Human Carcinogen per ACGIH {A2} - Suspected Human Carcinogen per ACGIH {A3} - Confirmed Animal Carcinogen with Unknown Relevance to Humans per ACGIH {A4} - Not Classifiable as a Human Carcinogen per ACGIH {A5} - Not Suspected as a Human Carcinogen per ACGIH (non-crystalline) form OSHA - U.S. Occupational Safety and Health Administration ACGIH - American Conference of Governmental Industrial Hygienists

VENTILATION: Use enough ventilation or local exhaust at the arc or both to keep the fumes and gases below the PEL/TLV in the worker's breathing zone and the general area. Train the welder to keep his head out of the fumes.
RESPIRATORY PROTECTION: Use NIOSH approved or equivalent fume respirator or air supplied respirator when welding in confined space or where local exhaust or ventilation does not keep exposure below the regulatory limits.
EYE PROTECTION: Wear helmet or use face shield with filter lens for open arc welding processes. As a rule of thumb begin with Shade Number 14. Adjust if needed by selecting the next lighter and/or darker shade number. Provide protective screens and flash goggles, if necessary, to shield others from the weld arc flash.
PROTECTIVE CLOTHING: Wear hand, head and body protection which help to prevent injury from radiation, sparks and electrical shock. See ANSI Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection as well as dark non-synthetic clothing. Train the welder not to touch live electrical parts and to insulate himself from work and ground.
PROCEDURE FOR CLEANUP OF SPILLS OR LEAKS: Not applicable
SPECIAL PRECAUTIONS (IMPORTANT): When welding with electrodes that require special ventilation (such as stainless or hard facing, or other products which require special ventilation, or on lead- or cadmium-plated steel and other metals or coatings like galvanized steel, which produce hazardous fumes) maintain exposure below the PEL/TLVL. Use industrial hygiene monitoring to ensure that your use of this material does not create exposures which exceed PEL/TLV. Always use exhaust ventilation. Refer to the following sources for important additional information: American National Standard Institute (ANSI) Z49.1; Safety in Welding and Cutting published by the American Welding Society, 8669 NW 36 Street, Suite #130, Miami, FL 33166-6672 , Phone: 800-443-9353 or 305-443-9353, and OSHA Publication 2206 (29 CFR 1910), U.S. Government Printing Office, Washington, DC 20402.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

Welding consumables applicable to this sheet as shipped are nonreactive, nonflammable, non-explosive and essentially nonhazardous until welded.
PHYSICAL STATE: Solid
APPEARANCE: Solid round wire
COLOR: Gray
ODOR: Not Applicable
ODOR THRESHOLD: Not Applicable
pH: Not Applicable
MELTING POINT/FREEZING POINT: Not Available
INITIAL BOILING POINT AND BOILING RANGE: Not Available
FLASH POINT: Not Available
EVAPORATION RATE: Not Applicable
FLAMMABILITY (SOLID, GAS): Not Available
UPPER/LOWER FLAMMABILITY OR EXPLOSIVE LIMITS: Not Available
VAPOR PRESSURE: Not Applicable
VAPOR DENSITY: Not Applicable
RELATIVE DENSITY: Not Available
SOLUBILITY(IES): Not Available
PARTITION COEFFICIENT: N-OCTANOL/WATER: Not Applicable
AUTO-IGNITION TEMPERATURE: Not Available
DECOMPOSITION TEMPERATURE: Not Available
VISCOSITY: Not Applicable

SECTION 10 – STABILITY AND REACTIVITY

GENERAL: Welding consumables applicable to this sheet are solid and nonvolatile as shipped. This product is only intended for use per the welding parameters it was designed for. When this product is used for welding, hazardous fumes may be created. Other factors to consider include the base metal, base metal preparation and base metal coatings. All of these factors can contribute to the fume and gases generated during welding. The amount of fume varies with the welding parameters.
STABILITY: This product is stable under normal conditions.
REACTIVITY: Contact with acids or strong bases may cause generation of gas.

SECTION 11 – TOXICOLOGICAL INFORMATION

Short-Term (Acute) Overexposure Effects: Welding Fumes - May result in discomfort such as dizziness, nausea or dryness or irritation of nose, throat or eyes. **Chromium** - Inhalation of fume with chromium (VI) compounds can cause irritation of the respiratory tract, lung damage and asthma-like symptoms. Swallowing chromium (VI) salts can cause severe injury or death. Dust on skin can form ulcers. Eyes may be burned by chromium (VI) compounds. Allergic reactions may occur in some people. **Copper** - Metal fume fever characterized by metallic taste, tightness of chest and fever. Symptoms may last 24 to 48 hours following overexposure. **Iron, Iron Oxide** - None are known. Treat as nuisance dust or fume. **Manganese** - Metal fume fever characterized by chills, fever, upset stomach, vomiting, irritation of the throat and aching of body. Recovery is generally complete within 48 hours of the overexposure. **Molybdenum** - Irritation of the eyes, nose and throat. **Nickel, Nickel Compounds** - Metallic taste, nausea, tightness in chest, metal fume fever, allergic reaction. **Niobium** - Dust or fumes may cause irritation of the respiratory system, skin and eyes. **Silica (Amorphous)** - Dust and fumes may cause irritation of the respiratory system, skin and eyes.

Long-Term (Chronic) Overexposure Effects: Welding Fumes - Excess levels may cause bronchial asthma, lung fibrosis, pneumoconiosis or "siderosis." Studies have concluded that there is sufficient evidence for ocular melanoma in welders. **Chromium** - Ulceration and perforation of nasal septum. Respiratory irritation may occur with symptoms resembling asthma. Studies have shown that chromate production workers exposed to hexavalent chromium compounds have an excess of lung cancers. Chromium (VI) compounds are more readily absorbed through the skin than chromium (III) compounds. Good practice requires the reduction of employee exposure to chromium (III) and (VI) compounds. **Copper** - Copper poisoning has been reported in the literature from exposure to high levels of copper. Liver damage can occur due to copper accumulating in the liver characterized by cell destruction and cirrhosis. High levels of copper may cause anemia and jaundice. High levels of copper may cause central nervous system damage characterized by nerve fiber separation and cerebral degeneration. **Iron, Iron Oxide Fumes** - Can cause siderosis (deposits of iron in lungs) which some researchers believe may

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affect pulmonary function. Lungs will clear in time when exposure to iron and its compounds ceases. Iron and magnetite (Fe_3O_4) are not regarded as fibrogenic materials. **Manganese** - Long-term overexposure to manganese compounds may affect the central nervous system. Symptoms may be similar to Parkinson's disease and can include slowness, changes in handwriting, gait impairment, muscle spasms and cramps and less commonly, tremor and behavioral changes. Employees who are overexposed to manganese compounds should be seen by a physician for early detection of neurologic problems. Overexposure to manganese and manganese compounds above safe exposure limits can cause irreversible damage to the central nervous system, including the brain, symptoms of which may include slurred speech, lethargy, tremor, muscular weakness, psychological disturbances and spastic gait. **Molybdenum** - Prolonged overexposure may result in loss of appetite, weight loss, loss of muscle coordination, difficulty in breathing and anemia. **Nickel, Nickel Compounds** - Lung fibrosis or pneumoconiosis. Studies of nickel refinery workers indicated a higher incidence of lung and nasal cancers. **Niobium** - No adverse long term health effects have been reported in the literature. **Silica (Amorphous**) - Research indicates that silica is present in welding fume in the amorphous form. Long term overexposure may cause pneumoconiosis. Non-crystalline forms of silica (amorphous silica) are considered to have little fibrotic potential.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Persons with pre-existing impaired lung functions (asthma-like conditions). Persons with a pacemaker should not go near welding and cutting operations until they have consulted their doctor and obtained information from the manufacturer of the device. Respirators are to be worn only after being medically cleared by your company-designated physician.

EMERGENCY AND FIRST AID PROCEDURES: Call for medical aid. Employ first aid techniques recommended by the American Red Cross. If irritation or flash burns develop after exposure, consult a physician.

CARCINOGENICITY: Chromium VI compounds, nickel compounds and silica (crystalline quartz) are classified as IARC[E] Group 1 and NTP[Z] Group K carcinogens. Welding fumes are classified as IARC Group 2B carcinogens.

CALIFORNIA PROPOSITION 65: WARNING: These products contain or produce a chemical known to the State of California to cause cancer and birth defects (or other reproductive harm). (California Health & Safety Code Section 25249.5 et seq.)

INGREDIENT	CAS	IARC[E]	NTP[Z]	OSHA[H]	65[Θ]
CHROMIUM	7440-47-3	3[Σ],1[ΣΣ]	K[ΣΣ]	X[ΣΣ]	X[ΣΣ]
COPPER	7440-50-8	---	---	---	---
IRON	7439-89-6	---	---	---	---
MANGANESE	7439-96-5	---	---	---	---
MOLYBDENUM	7439-98-7	---	---	---	---
NICKEL	7440-02-0	2B[β], 1[ββ]	S[β], K[ββ]	---	X[β], X[ββ]
NIOBIUM	7440-03-1	---	---	---	---
SILICA	14808-60-7	1[Ψ]	K	---	X
(Amorphous Silica Fume)	69012-64-2	3	---	---	---
SILICON	7440-21-3	---	---	---	---
WELDING FUMES	---	2B	---	---	---

E – International Agency for Research on Cancer (1 – Carcinogenic to Humans, 2A – Probably Carcinogenic to Humans, 2B – Possibly Carcinogenic to Humans, 3 – Not Classifiable as to its Carcinogenicity to Humans, 4 Probably Not Carcinogenic to Humans) Z – US National Toxicology Program (K – Known Carcinogen, S – Suspected Carcinogen) H – OSHA Designated Carcinogen List Θ – California Proposition 65 (X – On Proposition 65 list) --- Dashes indicate the ingredient is not listed with the IARC, NTP, OSHA or Prop 65 Σ – Metal and Chromium III Compounds ΣΣ – Chromium VI Ψ – Silica Crystalline α-Quartz β – Nickel metal and alloys ββ -- Nickel compounds

SECTION 12 – ECOLOGICAL INFORMATION

Welding processes can release fumes directly to the environment. Welding wire can degrade if left outside and unprotected. Residues from welding consumables and processes could degrade and accumulate in the soil and groundwater.

SECTION 13 – DISPOSAL CONSIDERATIONS

Use recycling procedures if available. Discard any product, residue, packaging, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state and local regulations.

SECTION 14 – TRANSPORT INFORMATION

No international regulations or restrictions are applicable. No special precautions are necessary.

SECTION 15 – REGULATORY INFORMATION

Read and understand the manufacturer's instructions, your employer's safety practices and the health and safety instructions on the label and the safety data sheet. Observe all local and federal rules and regulations. Take all necessary precautions to protect yourself and others.
United States EPA Toxic Substance Control Act: All constituents of these products are on the TSCA inventory list or are excluded from listing.

CERCLA/SARA TITLE III: Reportable Quantities (RQs) and/or Threshold Planning Quantities (TPQs):

Ingredient name	RQ(lb)	TPQ (lb)
Products on this SDS are a solid solution in the form of a solid article.	--	--

Spills or releases resulting in the loss of any ingredient at or above its RQ require immediate notification to the National Response Center and to your Local Emergency Planning Committee.

Section 311 Hazard Class
As shipped: Immediate In use: Immediate delayed

EPCRA/SARA TITLE III 313 TOXIC CHEMICALS: The following metallic components are listed as SARA 313 "Toxic Chemicals" and potentially subject to annual SARA 312 reporting:, Chromium, , Copper, Manganese, and Nickel. See Section 3 for weight percentage.

CANADIAN WHMIS CLASSIFICATION: Class D; Division 2, Subdivision A

CANADIAN CONTROLLED PRODUCTS REGULATION: This product has been classified in accordance with the hazard criteria of the CPR and the SDS contains all of the information required by the CPR.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA): All constituents of these products are on the Domestic Substance List (DSL).

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SECTION 16 – OTHER INFORMATION

The following Hazard Statements, provided in the OSHA Hazard Communication Standard (29 CFR Part 1910.1200) correspond to the columns labeled 'GHS Hazard Statements' within Section 3 of this safety data sheet. Take appropriate precautions and protective measures to eliminate or limit the associated hazard.

H271: May cause fire or explosion; strong oxidizer
H301: Toxic if swallowed
H302: Harmful if swallowed
H311: Toxic in contact with skin
H314: Causes severe skin burns and eye damage
H317: May cause an allergic skin reaction
H319: Causes serious eye irritation
H330: Fatal if inhaled
H332: Harmful if inhaled
H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled
H335: May cause respiratory irritation
H340: May cause genetic defects
H350: May cause cancer
H351: Suspected of causing cancer
H361f: Suspected of damaging fertility or the unborn child
H372: Causes damage to organs through prolonged or repeated exposure
H373: May cause damage to organs through prolonged or repeated exposure
H400: Very toxic to aquatic life.
H410: Very toxic to aquatic life with long lasting effects
H412: Harmful to aquatic life with long lasting effects.

For additional information please refer to the following sources:

USA: **American National Standard Institute (ANSI) Z49.1** "Safety in Welding and Cutting", **ANSI/American Welding Society (AWS) F1.5** "Methods for Sampling and Analyzing Gases from Welding and Allied Processes", **ANSI/AWS F1.1** "Method for Sampling Airborne Particles Generated by Welding and Allied Processes", **AWSF3.2M/F3.2** "Ventilation Guide for Weld Fume", American Welding Society, 8669 NW 36 Street, # 130, Miami, Florida 33166-6672, Phone: 800-443-9353 or 305-443-9353. Safety and Health Fact Sheets available from AWS at www.aws.org.
OSHA Publication 2206 (29 C.F.R. 1910), U.S. Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.
Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (ACGIH), 6500 Glenway Ave., Cincinnati, Ohio 45211, USA.
NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work" published by the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169.

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Canada: **CSA Standard CAN/CSA-W117.2-01** "Safety in Welding, Cutting and Allied Processes".

Hobart Brothers Company strongly recommends the users of this product study this SDS, the product label information and become aware of all hazards associated with welding. Hobart Brothers Company believes this data to be accurate and to reflect qualified expert opinion regarding current research. However, Hobart Brothers Company cannot make any expressed or implied warranty as to this information.

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards .This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard (29 CFR 1910.1200). Other government regulations must be reviewed for applicability to these products.

WARNING: PRODUCT COMPONENTS PRESENT HEALTH AND SAFETY HAZARDS. READ AND UNDERSTAND THIS MATERIAL SAFETY DATA SHEET (M.S.DS.). ALSO, FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES. This product may contain Chromium and/or Nickel which are listed by OSHA, NTP, or IARC as being a carcinogen or potential carcinogen. Use of this product may expose you or others to fumes and gases at levels exceeding those established by the American Conference of Governmental Industrial Hygienists (ACGIH) or the Occupational Safety and Health Administration (OSHA) The information contained herein relates only to the specific product. If the product is combined with other materials, all component properties must be considered. **BE SURE TO CONSULT THE LATEST VERSION OF THE MSDS. MATERIAL SAFETY DATA SHEETS ARE AVAILABLE FROM HARRIS PRODUCTS GROUP** salesinfo@jwharris.com 513-754-2000 **www.harrisproductsgroup.com**

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PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED): **ER70S-2, ER70S-3, ER70S-6, and ER80S-D2**

CHEMICAL NAME/CLASS: Metal Alloy

SYNONYMS: Not Applicable

PRODUCT USE: Metal Welding

DOCUMENT NUMBER: 0073

SUPPLIER/MANUFACTURER'S NAME: **HARRIS PRODUCTS GROUP**

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DATE OF PREPARATION: July 30, 2010

2. COMPOSITION and INFORMATION ON INGREDIENTS

Class	C	Mn	Si	P	S	Cu (d)	Mo	Fe
ER70S-2 (a)	0.07	0.90-1.40	0.40-0.70	0.025	0.035	0.50	(e)	Balance
ER70S-3	0.06-0.15	0.90-1.40	0.45-0.75	0.025	0.035	0.50	(e)	Balance
ER70S-6	0.06-0.15	1.40-1.85	0.80-1.15	0.025	0.035	0.50	(e)	Balance
ER80S-D2(c)	0.07-0.12	1.60-2.10	0.50-0.80	0.025	0.025	0.50	0.40-0.60	Balance

Single values are maximums. (a) Ti=0.05-0.15, Zr=0.02-0.12, Al=0.05-0.15 (e) Ni, Cr, Mo (0.15% maximum EACH), V = 0.03% maximum ,

(d) Cu elements shall not exceed 0.50% in total (including coating) (c)=Ni 0.15% maximum, Other totals =0.50%

2. COMPOSITION and INFORMATION ON INGREDIENTS (Continued)

CHEMICAL NAME	CAS #	EXPOSURE LIMITS IN AIR					
		ACGIH		OSHA			
		TLV mg/m^3	STEL mg/m^3	PEL mg/m^3	STEL mg/m^3	IDLH mg/m^3	OTHER mg/m^3
Iron (exposure limits are for iron oxide dust and fume [Fe_2O_3], as Fe)	1309-37-1	5, A4 (Not Classifiable as a Human Carcinogen)	NE	10	NE	2500	NIOSH REL: 5 DFG MAK: 6
Aluminum (exposure limits are for Aluminum, welding fumes, as Aluminum)	7429-90-5	5	NE	5 (vacated 1989 PEL)	NE	NE	NIOSH REL: 5
Graphite (Synthetic) (exposure limits are for Particles Not Otherwise Specified)	7782-42-5	2	NE	50 mppcf or 15 (Total Dust) 15 mppcf or 5 (Respirable Fraction)	NE	NE	DFG MAKs: TWA = 4 (Inhalable fraction); 1.5 (Respirable Fraction)
Copper (exposure limits are for Copper fume, as Copper)	7440-50-8	0.2	NE	0.1	NE	100	NIOSH REL: 0.1 DFG MAK: 0.1 (Respirable fraction)
Manganese (exposure limits are for Manganese, elemental, inorganic compounds, and fume, as Mn)	7439-96-5	0.2	NE	1 (vacated 1989 PEL)	5 C 3 (vacated 1989 PEL)	500	NIOSH REL: TWA = 1 STEL = 3 DFG MAK: 0.5 Carcinogen: EPA-D
Phosphorus	7723-14-0	0.1	NE	0.1	NE	5	NIOSH REL: TWA = 0.1 DFG MAK: TWA = 01 (respirable fraction) PEAK = 2•MAK, 5 min., momentary value DFG MAK Pregnancy Risk Classification: D Carcinogen: EPA-D
Sulfur	7704-34-9	5	NE	NE	NE	NE	NE
Molybdenum	7439-98-7	15	NE	15 10(vacated 1989 PEL)	NE	5000	NE
Silicon	7440-21-3	10	NE	15 (Total dust) 5 (Respirable fraction) 10 (Total dust) (vacated 1989 PEL)	NE	NE	NIOSH REL: 10 (Total dust) 5 (Respirable fraction)
Titanium	7440-32-6	NE	NE	NE	NE	NE	NE
Zirconium	7440-67-7	5, A4 (Not Classifiable as a Human Carcinogen)	10, A4	5	10 (vacated 1989 PEL)	50	NIOSH REL: TWA = 5 STEL: 10 DFG MAK = 5 (Total dust)

NE = Not Established. C = Ceiling Limit. See Section 16 for Definitions of Terms Used.
NOTE (1): The ACGIH has an established exposure limit for Welding Fumes, Not Otherwise Classified. The Threshold Limit Value is 5 mg/m^3. NIOSH classifies welding fumes as carcinogens.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: These products consist of solid wire or rods, which are odorless and may be copper coated. There are no immediate health hazards associated with the wire or rod form of this product. These products are not reactive. If involved in a fire, these products may generate irritating iron fumes and a variety of metal oxides. Emergency responders must wear personal protective equipment suitable for the situation to which they are responding.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of over-exposure for these products are by skin or eye contact. During welding operations, the most significant route of over-exposure is via inhalation of fumes.

INHALATION: Inhalation is not anticipated to be a significant route of over-exposure to the wire or rods. Inhalation of large amounts of particulates generated by these products during metal processing operations may result in pneumoconiosis (a disease of the lungs). Repeated over-exposures, via inhalation, to the dusts or fumes generated by these products may have adverse effects on the lungs with possible pulmonary edema and emphysema (life threatening lung injuries). Refer to Section 10 (Stability and Reactivity) for information on the specific composition of welding fumes and gases.

CONTACT WITH SKIN or EYES: Contact of the wire or rod form of these products with the skin is not anticipated to be irritating. Contact with the wire or rod form of these products can be physically damaging to the eye. Fumes generated during welding operations can be irritating to the skin and eyes. Symptoms of skin over-exposure may include irritation and redness; prolonged or repeated skin over-exposures may lead to dermatitis. Contact with the molten wire or rods will burn contaminated skin or eyes.

SKIN ABSORPTION: Skin absorption is not known to be a significant route of over-exposure for any component of these products.

INGESTION: Ingestion is not anticipated to be a route of occupational exposure for these products**.**

INJECTION: Though not a likely route of occupational exposure for these products, injection (via punctures or lacerations in the skin) may cause local reddening, tissue swelling, and discomfort.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Symptoms associated with over-exposure to these products and the fumes generated during welding operations are as follows:

ACUTE: The chief acute health hazard associated with these products would be the potential for irritation of contaminated skin and eyes when exposed to fumes during welding operations. Inhalation of large amounts of particulates generated by these products during metal processing operations can result in pneumoconiosis (a disease of the lungs). Contact with the molten material will burn contaminated skin or eyes.

CHRONIC: Chronic skin over-exposure to the fumes of these products during welding operations may produce dermatitis (red, inflamed skin). Repeated over-exposures to the fumes generated by these products via inhalation can have adverse effects on the lungs (e.g., pulmonary edema and emphysema). Repeated or prolonged ingestion exposures to > 50–100 mg of Iron per day can result in deposition of iron in the body tissues, which can cause disease.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH	(BLUE)	0
FLAMMABILITY	(RED)	0
REACTIVITY	(YELLOW)	0
PROTECTIVE EQUIPMENT		X

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications for the rods

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

SKIN EXPOSURE: If fumes generated by welding operations involving these products contaminate the skin, begin decontamination with running water. If molten material contaminates the skin, immediately begin decontamination with cold, running water. Minimum flushing is for 15 minutes. Victim must seek medical attention if any adverse reaction occurs.

EYE EXPOSURE: If fumes generated by welding operations involving these products enter the eyes, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Victim must seek immediate medical attention.

INHALATION: If fumes generated by welding operations involving these products are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions.

INGESTION: Ingestion is not a likely route of exposure for this product. If swallowed call physician immediately! Do not induce vomiting unless directed by medical personnel. Rinse mouth with water if person is conscious. Never give fluids or induce vomiting if person is unconscious, having convulsions, or not breathing.

4. FIRST-AID MEASURES (Continued)

Victims of chemical exposure must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take a copy of label and MSDS to health professional with victim.

5. FIRE-FIGHTING MEASURES

FLASH POINT, °C (method): Not flammable.

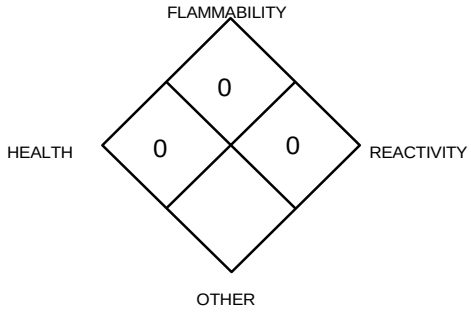
AUTOIGNITION TEMPERATURE, °C: Not flammable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.

Upper (UEL): Not applicable.

NFPA RATING



FIRE EXTINGUISHING MATERIALS:

Water Spray: YES	Carbon Dioxide: YES
Halon: YES	Foam: YES
Dry Chemical: YES	Other: Any "ABC" Class

UNUSUAL FIRE AND EXPLOSION HAZARDS When involved in a fire, these products may decompose and produce irritating fumes containing iron compounds and metal oxides. The molten material can present a significant thermal hazard to firefighters.

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: N/A

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: These products are solid metal rods, with no spill or leak hazards.

PART III *How can I prevent hazardous situations from occurring*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting these products ON YOU or IN YOU. Wash hands after handling these products. Do not eat or drink while handling these products. Use ventilation and other engineering controls to minimize potential exposure to these products.

STORAGE AND HANDLING PRACTICES: All employees who handle these products should be trained to handle it safely. Use in a well-ventilated location. Avoid breathing fumes of these products during welding operations. Open containers on a stable surface. Packages of these products must be properly labeled.

When these products are used during welding operations, follow the requirements of the Federal Occupational Safety and Health Welding and Cutting Standard (29 CFR 1910 Subpart Q) and the safety standards of the American National Standards Institute for welding and cutting (ANSI Z49.1).

Store packages in a cool, dry location. Storage in an atmosphere that is wet, moist, or highly humid may lead to corrosion of these products. Store away from incompatible materials (see Section 10, Stability and Reactivity).

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided in Section 2 (Composition and Information on Ingredients). Prudent practice is to ensure eyewash/safety shower stations are available near areas where these products are used.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below guidelines listed in Section 2 (Composition and Information on Ingredients). If respiratory protection is needed (i.e., a Weld Fume Respirator, or Air-Line Respirator for welding in confined spaces), use only protection authorized in 29 CFR 1910.134 or applicable State regulations. Respiratory Protection is recommended to be worn during welding operations. Use supplied air respiration protection if oxygen levels are below 19.5% or are unknown.

EYE PROTECTION: Safety glasses. When these products are used in conjunction with welding, wear safety glasses, goggles, or face-shield with filter lens of appropriate shade number (per ANSI Z49.1-1988, "Safety in Welding and Cutting").

HAND PROTECTION: Wear gloves for routine industrial use. When these products are used in conjunction with welding, wear gloves that protect from sparks and flame (per ANSI Z49.1-1988, "Safety in Welding and Cutting").

BODY PROTECTION: Wear body protection appropriate for task.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for elemental iron:

RELATIVE VAPOR DENSITY (air = 1): Not applicable.

EVAPORATION RATE (nBuAc = 1): Not applicable.

SPECIFIC GRAVITY (water = 1): 7.86

FREEZING/MELTING POINT: 1535°C (2795°F)

SOLUBILITY IN WATER: Insoluble.

pH: Not applicable.

VAPOR PRESSURE, mm Hg @ 20°C: Not applicable.

BOILING POINT: 3000°C (5432°F)

ODOR THRESHOLD: Not applicable.

COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT): Not applicable.

The following information is for the product:

APPEARANCE AND COLOR: These products consist of solid wire or rods, which are odorless and may be copper coated.

HOW TO DETECT THIS SUBSTANCE (warning properties): The appearance is a distinctive characteristic of these products.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: Iron compounds and metal oxides.

NOTE: The composition and quality of welding fumes and gases are dependent upon the metal being welded, the process, the procedure, and the electrodes used. Other conditions that could also influence the composition and quantity of fumes and gases to which workers may be exposed include the following: any coatings on metal being welded (e.g., paint, plating, or galvanizing), the number of welders and the volume of the work area, the quality of ventilation, the position of the welder's head with respect to the fume plume, and the presence of other contaminates in the atmosphere. When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 2 (Composition and Information on Ingredients). Fume and gas decomposition products, and not the ingredients in the electrode, are important. Concentration of the given fume or gas component may decrease or increase by many times the original concentration. New compounds in the electrode may form. Decomposition products of normal operations include not only those originating from volatilization, reaction, or oxidation of the product's components but also those from base metals and any coating (as noted previously). The best method to determine the actual composition of generated fumes and gases is to take an air sample from inside the welder's helmet if worn or in breathing zone. For additional information, refer to the American Welding Society Publication, "Fumes and Gases in the Welding Environment".

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids, strong oxidizers, mineral acids, and halogens.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Uncontrolled exposure to extreme temperatures, Incompatible materials.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: Presented below are human toxicological data available for the components of these products present in concentration greater than 1%. Other data for animals are available for the components of these products, but are not presented in this Material Safety Data Sheet.

COPPER:

TDLo (oral, human) = 120 μg/kg; gastrointestinal tract effects

IRON:

TDLo (oral, child) = 77 mg/kg; BAH, gastrointestinal tract, blood effects

MANGANESE:

TCLo (inhalation, man) = 2300 $\mu g/m^3$; BRN, central nervous system effects

SUSPECTED CANCER AGENT: Carbon (a component of these products) is on the following lists:

IARC Group 3, Not Classifiable as to Carcinogenicity to Humans.
NIOSH-X, Carcinogen defined with no further categorization.

Manganese (a component of these products) is on the following list:

EPA-D, Not Classifiable as to Human Carcinogenicity (inadequate human and animal evidence of carcinogenicity or no data available).

The other components of these products are not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, and CAL/OSHA and therefore are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: Dusts or fumes of these products may be irritating to contaminated skin and eyes. Fumes may be irritating to the respiratory system.

SENSITIZATION TO THE PRODUCT: The components of these products are not known to be sensitizers with repeated or prolonged use.

11. TOXICOLOGICAL INFORMATION (Continued)

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of these products and their components on the human reproductive system.

Mutagenicity: These products are not reported to produce mutagenic effects in humans. Animal mutation data are available for Carbon and Molybdenum (components of these products); these data were obtained during clinical studies on specific animal tissues exposed to high doses of this compound.

Embryotoxicity These products are not reported to produce embryotoxic effects in humans.

Teratogenicity: These products are not reported to cause teratogenic effects in humans. Clinical studies on test animals exposed to relatively high doses of Copper and Molybdenum (components of these products) indicate teratogenic effects.

Reproductive Toxicity: These products are not reported to cause reproductive effects in humans. Clinical studies on test animals exposed to relatively high doses of Copper, Molybdenum, and Titanium (components of these products) indicate adverse reproductive effects.

A mutagen is a chemical, which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical, which causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical, which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance, which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Skin, respiratory, pancreas, and liver disorders may be aggravated by prolonged over-exposures to the dusts or fumes generated by these products.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate overexposure.

BIOLOGICAL EXPOSURE INDICES: Currently, there are no Biological Exposure Indices (BEIs) associated with the components of these products.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: The components of these products occur naturally in the environment and are expected to persist in the environment for an extended period of time. Iron will react with water and air to form a variety of stable iron oxides.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: The components of these products occur naturally in the environment and are essential for plant and animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: These products are not expected to cause adverse effects on aquatic life.

COPPER: Copper is concentrated by plankton by 1000 or more. Copper may concentrate to toxic level in the food chain.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. These products, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

EPA WASTE NUMBER: Not applicable to wastes consisting of only this product.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS NOT HAZARDOUS (Per 49 CFR 172.101) BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME:	Not applicable.
HAZARD CLASS NUMBER and DESCRIPTION:	Not applicable.
UN IDENTIFICATION NUMBER:	Not applicable.
PACKING GROUP:	Not applicable.
DOT LABEL(S) REQUIRED:	Not applicable.

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER, 1996: Not applicable.

MARINE POLLUTANT: No component of these products is designated as a marine pollutant by the Department of Transportation (49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS NOT CONSIDERED AS DANGEROUS GOODS.

15. REGULATORY INFORMATION

SARA REPORTING REQUIREMENTS: The components of these products are subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

COMPONENT	SARA 302	SARA 304	SARA 313
Aluminum (fume or dust)	No	No	Yes
Copper	No	Yes	Yes
Manganese	No	No	Yes

SARA THRESHOLD PLANNING QUANTITY: Not applicable.

TSCA INVENTORY STATUS: The components of these products are listed on the TSCA Inventory.

CERCLA REPORTABLE QUANTITY (RQ): Copper = 5000 lbs. (for particulates less than 100 micrometers in size).

OTHER FEDERAL REGULATIONS: Not applicable.

STATE REGULATORY INFORMATION: The components of these products are covered under specific State regulations, as denoted below:

Alaska-Designated Toxic and Hazardous Substances: Aluminum Welding Fumes, Carbon Black, Manganese, and Molybdenum.

California-Permissible Exposure Limits for Chemical Contaminants: Aluminum, Carbon Black, Copper, Manganese, and Silicon.

Florida-Substance List: Aluminum, Manganese, Molybdenum, and Zirconium.

Illinois-Toxic Substance List: Aluminum, Carbon Black, Copper, Manganese, Molybdenum, and Silicon.

Kansas-Section 302/313 List: Aluminum, Copper, and Manganese.

Massachusetts-Substance List: Aluminum, Carbon Black, Copper, Manganese, Molybdenum, and Zirconium.

Michigan - Critical Materials Register: Copper.

Minnesota-List of Hazardous Substances: Aluminum Welding Fumes, Carbon Black, Manganese, and Silicon.

Missouri-Employer Information/Toxic Substance List: Aluminum, Carbon Black, Copper, Manganese, Molybdenum, Silicon, and Zirconium.

New Jersey-Right to Know Hazardous Substance List: Aluminum, Carbon Black, Copper, Manganese, Molybdenum, Titanium, and Zirconium.

North Dakota-List of Hazardous Chemicals, Reportable Quantities: Copper.

Pennsylvania-Hazardous Substance List: Aluminum, Carbon Black, Copper, Manganese, Molybdenum, Silicon, and Zirconium.

Rhode Island-Hazardous Substance List: Aluminum Welding Fumes, Carbon Black, Manganese, Molybdenum, Silicon, and Zirconium.

Texas-Hazardous Substance List: Carbon Black, Manganese, and Molybdenum.

West Virginia-Hazardous Substance List: Carbon Black, Manganese, and Molybdenum.

Wisconsin-Toxic and Hazardous Substances: Carbon Black, Manganese, and Molybdenum.

CALIFORNIA PROPOSITION 65: No component of these products is on the California Proposition 65 List. **WARNING: This product may contain chemicals, and when used for welding may produce fumes or gases containing chemicals, known to the State of California to cause cancer, and/or birth defects (or other reproductive harm.)**

LABELING (Precautionary Statements):

WARNING: PROTECT yourself and others. Read and understand this information.

FUMES AND GASES can be hazardous to your health.
ARC RAYS can injure eyes and burn skin.
ELECTRIC SHOCK can KILL.

- Before use, read and understand the manufacturer's instructions, Material Safety Data Sheets (MSDSs), and your employer's safety practices.
- Keep your head out of the fumes.
- Use enough ventilation, exhaust at the arc, or both, to keep fumes and gases from your breathing zone and the general area.
- Wear correct eye, ear, and body protection.
- Do not touch live electrical parts.

- See American National Standard Z49.1, *Safety in Welding, Cutting , and Allied Processes*, published by the American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126; OSHA Safety and Health Standards, available from the U.S. Government Printing Office, Superintendent office, P.O. Box 371954, Pittsburgh, PA 15250-7954.

DO NOT REMOVE THIS INFORMATION

TARGET ORGANS: For fumes: Skin, eyes, respiratory system, pancreas and liver.

WHMIS SYMBOLS: Not applicable.

16. OTHER INFORMATION

DATE OF PRINTING: July 19, 2012

This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard (29 CFR 1910.1200). Other government regulations must be reviewed for applicability to these products. The information contained herein relates only to the specific product. If the product is combined with other materials, all component properties must be considered. To the best of the J.W. Harris Company, Inc.'s knowledge, the information and recommendations contained in this publication are reliable and accurate as of the date of issue. However, accuracy, suitability, or completeness are not guaranteed, and no warranty, guarantee, or representation, expressed or implied, is made by J.W. Harris Co., Inc. as to the absolute correctness or sufficiency of any representation contained in this and other publications Harris Products Group assumes no responsibility in connection therewith; nor can it be assumed that all acceptable safety measures may not be required under particular or exceptional conditions or circumstances. Data may be changed from time to time. Be sure to consult the latest edition.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these, which are commonly used, include the following:

CAS #: This is the Chemical Abstract Service Number, which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:
ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **IARC**-International Agency for Research on Cancer
TLV - Threshold Limit Value - an airborne concentration of a substance, which represents conditions under which it is generally believed that nearly all workers, may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour **Time Weighted Average (TWA)**, the 15-minute **Short Term Exposure Limit**, and the instantaneous **Ceiling Level**. Skin absorption effects must also be considered.
OSHA - U.S. Occupational Safety and Health Administration.
PEL - Permissible Exposure Limit - this exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL, which was vacated by Court Order.
IDLH - **Immediately Dangerous to Life and Health** level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. **O**ccupational **S**afety and **H**ealth **A**dministration (**OSHA**). NIOSH issues exposure guidelines called **R**ecommended **E**xposure **L**evels (**REL**s). When no exposure guidelines are established, an entry of **NE** is made for reference. **NTP**- National Toxicology Program

FLAMMABILITY LIMITS IN AIR: Much of the information related to fire and explosion is derived from the **N**ational **F**ire **P**rotection **A**ssociation (**NFPA**). LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION
Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD_{50}** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC_{50}** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause death. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

REGULATORY INFORMATION
This section explains the impact of various laws and regulations on the material. The acronyms used are: **EPA** is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and Transport Canada, respectively. **Superfund Amendments and Reauthorization Act (SARA)**; the **Toxic Substance Control Act (TSCA)**; Marine Pollutant status according to the **DOT**; California's Safe Drinking Water Act (**Proposition 65**); the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund)**; and various state regulations. This section also includes information on the precautionary warnings, which appear, on the materials package label.

Safety Data Sheet

According to OSHA HCS 2012 (29 CFR 1910.1200)

Section 1: Identification

Product Identifier: **Honda Genuine Ultimate Full Synthetic Motor Oil**

Other means of identification:
Honda Genuine Ultimate Full Synthetic Motor Oil, SAE 0W-20
Honda Genuine Ultimate Full Synthetic Motor Oil, SAE 5W-20
Honda Genuine Ultimate Full Synthetic Motor Oil, SAE 5W-30
Honda Genuine Ultimate Full Synthetic Motor Oil, SAE 10W-30

SDS Number: **817725**

Intended Use: Automotive Engine Oil

Uses Advised Against: All others

Emergency Health and Safety Number:
CHEMTREC 800-424-9300 (24 Hours)
CANUTEC 613-996-6666
CHEMTREC Mexico 01-800-681-9531

Manufacturer:
Phillips 66 Lubricants
P.O. Box 4428
Houston, TX 77210

SDS Information:
Phone: 800-762-0942
Email: SDS@P66.com
URL: www.Phillips66.com

Customer Service:
U.S.: 1-800-822-6457 or International: +1-83-2486-3363
Technical Information: 1-877-445-9198

Section 2: Hazards Identification

Classified Hazards
This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Other Hazards
None Known

Label Elements

No classified hazards

Section 3: Composition / Information on Ingredients

Chemical Name	CASRN	Concentration[1]
Distillates, petroleum, hydrotreated heavy paraffinic	64742-54-7	>80
Non-Hazardous Materials	VARIOUS	<20

[1] All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

Section 4: First Aid Measures

Eye Contact: If irritation or redness develops from exposure, flush eyes with clean water. If symptoms persist, seek medical attention.

Skin Contact: Remove contaminated shoes and clothing and cleanse affected area(s) thoroughly by washing with mild soap and water or a waterless hand cleaner. If irritation or redness develops and persists, seek medical attention.

Inhalation (Breathing): First aid is not normally required. If breathing difficulties develop, move victim away from source of exposure and into fresh air in a position comfortable for breathing. Seek immediate medical attention.

Ingestion (Swallowing): First aid is not normally required; however, if swallowed and symptoms develop, seek medical attention.

Most important symptoms and effects, both acute and delayed: Inhalation of oil mists or vapors generated at elevated temperatures may cause respiratory irritation. Accidental ingestion can result in minor irritation of the digestive tract, nausea and diarrhea. Dry skin and possible irritation with repeated or prolonged exposure.

Notes to Physician: Acute aspirations of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.

Section 5: Fire-Fighting Measures

NFPA 704 Hazard Class

Health: 0 **Flammability:** 1 **Instability:** 0

0 (Minimal)
1 (Slight)
2 (Moderate)
3 (Serious)
4 (Severe)

Extinguishing Media: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water or foam may cause frothing of materials heated above 212°F / 100°C. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

Specific hazards arising from the chemical

Unusual Fire & Explosion Hazards: This material may burn, but will not ignite readily. If container is not properly cooled, it can rupture in the heat of a fire.

Hazardous Combustion Products: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

Special protective actions for firefighters: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

See Section 9 for Flammable Properties including Flash Point and Flammable (Explosive) Limits

Section 6: Accidental Release Measures

Personal precautions, protective equipment and emergency procedures: This material may burn, but will not ignite readily. Keep all sources of ignition away from spill/release. Stay upwind and away from spill/release. Avoid direct contact with material. For large spillages, notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Wear appropriate protective equipment, including respiratory protection, as conditions warrant (see Section 8). See Sections 2 and 7 for additional information on hazards and precautionary measures.

Environmental Precautions: Stop spill/release if it can be done safely. Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Use water sparingly to minimize environmental contamination and reduce disposal requirements. If spill occurs on water notify appropriate authorities and advise shipping of any hazard. Spills into or upon navigable waters, the contiguous zone, or adjoining shorelines that cause a sheen or discoloration on the surface of the water, may require notification of the National Response Center (phone number 800-424-8802).

Methods and material for containment and cleaning up: Notify relevant authorities in accordance with all applicable regulations. Immediate cleanup of any spill is recommended. Dike far ahead of spill for later recovery or disposal. Absorb spill with inert material such as sand or vermiculite, and place in suitable container for disposal. If spilled on water remove with appropriate methods (e.g. skimming, booms or absorbents). In case of soil contamination, remove contaminated soil for remediation or disposal, in accordance with local regulations.

Recommended measures are based on the most likely spillage scenarios for this material; however local conditions and regulations may influence or limit the choice of appropriate actions to be taken. See Section 13 for information on appropriate disposal.

Section 7: Handling and Storage

Precautions for safe handling: Keep away from flames and hot surfaces. Wash thoroughly after handling. Use good personal hygiene practices and wear appropriate personal protective equipment (see section 8). Spills will produce very slippery surfaces. Used motor oils have been shown to cause skin cancer in mice after repeated application to the skin without washing. Brief or intermittent skin contact with used motor oil is not expected to cause harm if the oil is thoroughly removed by washing with soap and water. Do not enter confined spaces such as tanks or pits without following proper entry procedures such as ASTM D-4276 and 29CFR 1910.146. Do not wear contaminated clothing or shoes.

Conditions for safe storage: Keep container(s) tightly closed and properly labeled. Use and store this material in cool, dry, well-ventilated area away from heat and all sources of ignition. Store only in approved containers. Keep away from any incompatible material (see Section 10). Protect container(s) against physical damage.

"Empty" containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. "Empty" drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations. Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSI Z49.1, and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Section 8: Exposure Controls / Personal Protection

Chemical Name	ACGIH	OSHA	Other
Distillates, petroleum, hydrotreated heavy paraffinic	TWA: 5mg/m³ STEL: 10 mg/m³ as Oil Mist, if Generated	TWA: 5mg/m³ as Oil Mist, if Generated	---

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentrations below the established exposure limits, additional engineering controls may be required.

Eye/Face Protection: The use of eye protection that meets or exceeds ANSI Z.87.1 is recommended to protect against potential eye contact, irritation, or injury. Depending on conditions of use, a face shield may be necessary.

Skin/Hand Protection: The use of gloves impervious to the specific material handled is advised to prevent skin contact. Users should check with manufacturers to confirm the breakthrough performance of their products. Suggested protective materials: Nitrile

Respiratory Protection: Where there is potential for airborne exposure above the exposure limit a NIOSH certified air purifying respirator equipped with R or P95 filters may be used.

A respiratory protection program that meets or is equivalent to OSHA 29 CFR 1910.134 and ANSI Z88.2 should be followed whenever workplace conditions warrant a respirator's use. Air purifying respirators provide limited protection and cannot be used in atmospheres that exceed the maximum use concentration (as directed by regulation or the manufacturer's instructions), in oxygen deficient (less than 19.5 percent oxygen) situations, or under conditions that are immediately dangerous to life and health (IDLH).

Suggestions provided in this section for exposure control and specific types of protective equipment are based on readily available information. Users should consult with the specific manufacturer to confirm the performance of their protective equipment. Specific situations may require consultation with industrial hygiene, safety, or engineering professionals.

Section 9: Physical and Chemical Properties

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1 atm). Data represent typical values and are not intended to be specifications.

Appearance: Amber, Transparent
Physical Form: Liquid
Odor: Petroleum
Odor Threshold: No data
pH: Not applicable
Vapor Density (air=1): >1

Flash Point: Minimum 365 °F / 185 °C
Test Method: Pensky-Martens Closed Cup (PMCC), ASTM D93, EPA 1010
Initial Boiling Point/Range: No data
Vapor Pressure: <1 mm Hg
Partition Coefficient (n-octanol/water) (Kow): No data
Melting/Freezing Point: No data

Upper Explosive Limits (vol % in air): No data
Lower Explosive Limits (vol % in air): No data
Evaporation Rate (nBuAc=1): No data
Particle Size: N/A
Percent Volatile: No data
Flammability (solid, gas): N/A
Auto-ignition Temperature: No data
Decomposition Temperature: No data
Specific Gravity (water=1): 0.84 - 0.86 @ 60ºF (15.6ºC)
Bulk Density: 6.99 - 7.16 lbs/gal
Viscosity: 7.7 - 11.5 cSt @ 100°C; 40.0 - 66.0 cSt @ 40°C
Solubility in Water: Negligible

Section 10: Stability and Reactivity

Reactivity: Not chemically reactive.

Chemical stability: Stable under normal ambient and anticipated conditions of use.

Possibility of hazardous reactions: Hazardous reactions not anticipated.

Conditions to avoid: Extended exposure to high temperatures can cause decomposition. Avoid all possible sources of ignition.

Incompatible materials: Avoid contact with strong oxidizing agents and strong reducing agents.

Hazardous decomposition products: Not anticipated under normal conditions of use, During use in engines, contamination of oil with low levels of hazardous fuel combustion by-products may occur. Repeated and prolonged skin contact can cause drying and cracking.

Section 11: Toxicological Information

Information on Toxicological Effects of Substance/Mixture

Substance / Mixture

Acute Toxicity	Hazard	Additional Information	LC50/LD50 Data
Inhalation	Unlikely to be harmful		> 5 mg/L (estimated)
Dermal	Unlikely to be harmful		> 2 g/kg (estimated)
Oral	Unlikely to be harmful		> 5 g/kg (estimated)

Aspiration Hazard: Not expected to be an aspiration hazard.

Skin Corrosion/Irritation: Causes mild skin irritation. Repeated exposure may cause skin dryness or cracking.

Serious Eye Damage/Irritation: Causes mild eye irritation.

Skin Sensitization: No information available on the mixture, however none of the components have been classified for skin sensitization (or are below the concentration threshold for classification).

Respiratory Sensitization: No information available.

Specific Target Organ Toxicity (Single Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Specific Target Organ Toxicity (Repeated Exposure): No information available on the mixture, however none of the components have been classified for target organ toxicity (or are below the concentration threshold for classification).

Carcinogenicity: No information available on the mixture, however none of the components have been classified for carcinogenicity (or are below the concentration threshold for classification).

Germ Cell Mutagenicity: No information available on the mixture, however none of the components have been classified for germ cell mutagenicity (or are below the concentration threshold for classification).

Reproductive Toxicity: No information available on the mixture, however none of the components have been classified for reproductive toxicity (or are below the concentration threshold for classification).

Information on Toxicological Effects of Components

Distillates, petroleum, hydrotreated heavy paraffinic

Carcinogenicity: This oil has been highly refined by a variety of processes to reduce aromatics and improve performance characteristics. It meets the IP-346 criteria of less than 3 percent PAH's and is not considered a carcinogen by the International Agency for Research on Cancer.

Section 12: Ecological Information

GHS Classification:
No classified hazards

Toxicity: All acute aquatic toxicity studies on samples of lubricant base oils show acute toxicity values greater than 100 mg/L for invertebrates, algae and fish. These tests were carried out on water accommodated fractions and the results are consistent with the predicted aquatic toxicity of these substances based on their hydrocarbon compositions.

Persistence and Degradability: The hydrocarbons in this material are not readily biodegradable, but since they can be degraded by microorganisms, they are regarded as inherently biodegradable.

Bioaccumulative Potential: Log Kow values measured for the hydrocarbon components of this material are greater than 5.3, and therefore regarded as having the potential to bioaccumulate. In practice, metabolic processes may reduce bioconcentration.

Mobility in Soil: Volatilization to air is not expected to be a significant fate process due to the low vapor pressure of this material. In water, base oils will float and spread over the surface at a rate dependent upon viscosity. There will be significant removal of hydrocarbons from the water by sediment adsorption. In soil and sediment, hydrocarbon components will show low mobility with adsorption to sediments being the predominant physical process. The main fate process is expected to be slow biodegradation of the hydrocarbon constituents in soil and sediment.

Other adverse effects: None anticipated.

Section 13: Disposal Considerations

The generator of a waste is always responsible for making proper hazardous waste determinations and needs to consider state and local requirements in addition to federal regulations. This material, if discarded as produced, would not be a federally regulated RCRA "listed" hazardous waste and is not believed to exhibit characteristics of hazardous waste. See Sections 7 and 8 for information on handling, storage and personal protection and Section 9 for physical/chemical properties. It is possible that the material as produced contains constituents which are not required to be listed in the SDS but could affect the hazardous waste determination. Additionally, use which results in chemical or physical change of this material could subject it to regulation as a hazardous waste.This material under most intended uses would become "Used Oil" due to contamination by physical or chemical impurities. Whenever possible, Recycle used oil in accordance with applicable federal and state or local regulations. Container contents should be completely used and containers should be emptied prior to discard.

Section 14: Transport Information

U.S. Department of Transportation (DOT)

Shipping Description: *Not regulated*
Note: *If shipped by land in a packaging having a capacity of 3,500 gallons or more, the provisions of 49 CFR, Part 130 apply. (Contains oil)*

International Maritime Dangerous Goods (IMDG)

Shipping Description: *Not regulated*
Note: *U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 25.*

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Not applicable

International Civil Aviation Org. / International Air Transport Assoc. (ICAO/IATA)

UN/ID #: *Not regulated*

Note: *U.S. DOT compliance requirements may apply. See 49 CFR 171.22, 23 & 24.*

	LTD. QTY	Passenger Aircraft	Cargo Aircraft Only
Packaging Instruction #:	---	---	---
Max. Net Qty. Per Package:	---	---	---

Section 15: Regulatory Information

CERCLA/SARA - Section 302 Extremely Hazardous Substances and TPQs (in pounds):
This material does not contain any chemicals subject to the reporting requirements of SARA 302 and 40 CFR 372.

CERCLA/SARA - Section 311/312 (Title III Hazard Categories)

Acute Health Hazard: No
Chronic Health Hazard: No
Fire Hazard: No
Pressure Hazard: No
Reactive Hazard: No

CERCLA/SARA - Section 313 and 40 CFR 372:
This material does not contain any chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372.

EPA (CERCLA) Reportable Quantity (in pounds):
This material does not contain any chemicals with CERCLA Reportable Quantities.

California Proposition 65:
This material does not contain any chemicals which are known to the State of California to cause cancer, birth defects or other reproductive harm at concentrations that trigger the warning requirements of California Proposition 65.

International Hazard Classification

Canada:
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the Regulations.

WHMIS Hazard Class:
none

National Chemical Inventories
All components are either listed on the US TSCA Inventory, or are not regulated under TSCA.

All components are either on the DSL, or are exempt from DSL listing requirements.

U.S. Export Control Classification Number: EAR99

Section 16: Other Information

Date of Issue:	Previous Issue Date:	SDS Number:	Status:
27-Dec-2013	24-Oct-2012	817725	FINAL

Revised Sections or Basis for Revision:
Composition (Section 3)

Guide to Abbreviations:
ACGIH = American Conference of Governmental Industrial Hygienists; CASRN = Chemical Abstracts Service Registry Number; CEILING = Ceiling Limit (15 minutes); CERCLA = The Comprehensive Environmental Response, Compensation, and Liability Act; EPA = Environmental Protection Agency; GHS = Globally Harmonized System; IARC = International Agency for Research on Cancer; INSHT = National Institute for Health and Safety at Work; IOPC = International Oil Pollution Compensation; LEL = Lower Explosive Limit; NE = Not Established; NFPA = National Fire Protection Association; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration; PEL = Permissible Exposure Limit (OSHA); SARA = Superfund Amendments and Reauthorization Act; STEL = Short Term Exposure Limit (15 minutes); TLV = Threshold Limit Value (ACGIH); TWA = Time Weighted Average (8 hours); UEL = Upper Explosive Limit; WHMIS = Worker Hazardous Materials Information System (Canada)

Disclaimer of Expressed and implied Warranties:
The information presented in this Safety Data Sheet is based on data believed to be accurate as of the date this Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

Material Safety Data Sheet

Reference – MSDS
Date – March 2011

1. PRODUCT IDENTIFICATION & COMPANY INFORMATION

Product name: Various grades of welding and metal spraying consumable carrying the trademarks
DURANICKEL, INCOLOY, INCONEL, INCO-CORED, INCO-WELD, MONEL, Nickel, NILO, NIMONIC, NI-ROD, INCOFLUX
Full list given in tables 2.1-.2.4

Other/generic names: Filler Metal, Flux, Flux Cored, Welding Electrode, Weldstrip, & Thermal Spray (TSW)

Product use: Welding & metal spraying consumables, See applicable product technical data sheets on website for information of typical scope of use and application, not all products are suitable for all processes or applications.

Filler Metal	*Used for joining and overlaying, using GTAW, GMAW, Plasma and SAW (with suitable flux) welding processes*
Flux Cored	*Used for joining and overlaying, using GMAW welding processes*
Welding Electrode	*Used for joining and overlaying, using SMAW welding process*
Weldstrip	*Used for overlaying, (with suitable flux) for submerged arc or electroslag welding process*
INCOFLUX	*Flux used for joining or overlaying with appropriate filler metal or weldstrip for submerged arc or electroslag welding process*
Thermal Spray(TSW)	*Used to apply nickel alloy coating by a variety of thermal spray process*

Manufacturer:

Special Metals Welding Products Company

1401 Burris Road, Newton,
North Carolina 28658
United States

For more information
Tel +1 828-465-0352
Fax +1 828-464-8993
Email info@smwpc.com

c/o Special Metals Wiggin Ltd
Wiggin Works, Holmer Road,
Hereford, UK, HR4-9SL

Tel +44 (0)1432 382200
Fax +44 (0)1432 264030
Email sales.uk@smwpc.com

Australian Distributor - Alloys International Pty Ltd - 25 Raymond Road, Laverton North Vic 3026 Phone (03) 8368 2222

Emergency telephone **+1 828-465-0352** **+44 (0)1432 382200**

2. COMPOSITION/INFORMATION ON INGREDIENTS

Information on ingredients is given in Table 1 and the compositions of individual products in the alloy families or categories listed above are given in the product composition tables 2.1-2.4. Please refer to the appropriate alloy name or designation.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Silver to gray metal wire or strip. (Welding Electrodes are flux coated, Flux Cored has a flux center; flux is granular powder). Not normally considered hazardous as shipped. Ends and edges can be sharp and gloves should be worn when handling.

POTENTIAL HEALTH HAZARDS

Skin: Although not normally hazardous, some individuals can develop allergic skin reactions to nickel and other metallic ingredients. Ends of wire and edges of strips may be sharp and can cause cuts.
During welding and spraying - Fumes generated may be irritating to the skin. UV radiation produced can cause burns (ray burn). Hot metal can cause burns.

Eyes: As shipped, product does not pose a hazard to the eyes however ends of wire and edges of strip are sharp and can cause cuts.
During welding and spraying - Fumes generated can be irritating to the eye. Ends of wire may be sharp and can cause cuts or hot and cause burns. UV radiation produced can cause burns (arc eye).

Inhalation: Fumes generated by welding and spraying processes can be irritating and toxic.

Ingestion: Not a likely route of entry. Metal ingestion can cause toxic effects.

Delayed effects: Inhalation of welding or spraying fumes may cause damage to the lungs and respiratory tract including but not limited to fibrosis of the lung which can reduce lung capacity and produce difficulty breathing. Cobalt and Nickel are animal carcinogens and inhalation of fumes and dusts should be avoided. Prolonged inhalation of Manganese fumes and dusts may cause irreversible damage to the nervous system resulting in Parkinson's Disease-like symptoms (tremors, weakness, paralysis, etc.)

	Nickel	Cobalt
EC Label No	231-111-4	231-158-0
Index No	028-002-00-7	028-001-00-9
Designation:	Xn Harmful	Xn Harmful
Risk Phrases:	R40 Possible risk of irreversible effects R43 May cause sensitization by skin contact	R42/43 May cause sensitization by inhalation and skin contact R53 May cause long-term adverse effects in aquatic environments

4. FIRST AID MEASURES

Skin: Wash skin with soap and water to remove any metallic particles. If a rash or burn develops, seek medical attention.

Eyes: Flush particles from eyes with clean water for at least 15 minutes. If irritation persists or burn develops, seek medical attention.

Inhalation: Remove from exposure. If respiratory irritation persists, seek medical attention.

Ingestion: If metallic particles are swallowed, seek medical assistance.

Advice to physician: Treat symptomatically.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

Flash Point & Method	Solid material – No flash point
Autoignition Temperature:	Not flammable
Flame Propagation Rate (solids):	Not flammable
OSHA Flammability Class:	None – solid material

Extinguishing Media:	Use agent appropriate for surrounding fire.
Unusual Fire And Explosion Hazards:	None
Special Fire Fighting Precautions/Instructions:	Wear self-contained breathing apparatus. Hazardous metallic fumes can be generated in a fire.

Nonflammable except for packaging, however sparks from welding or grinding in user operations could ignite flammable or combustible liquids, vapors and solids.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: Wear proper protective clothing. Pick up spilled articles and place into container.

7. HANDLING AND STORAGE

Normal Handling: Under normal circumstances the materials do not produce any hazardous products and as such do not require any special precautions. However, see Section 10 "STABILITY AND REACTIVITY". The transient handling of the materials would not be expected to produce any sensitization but it is good practice to use gloves for handling. The normal precautions for handling heavy objects with possible sharp edges should also be observed.

Personal hygiene - Apply good standards, wash hands after use and before eating.

Storage Recommendations: Store in a dry place and protect from contamination with other materials.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide general ventilation and local exhaust ventilation when welding, spraying, cutting or grinding to maintain concentrations of metal dusts and/or fumes below allowable exposure values.
Maintain exposures below the published exposure levels. Use industrial hygiene air monitoring to ensure that your use of this material does not create exposures that exceed the recommended exposure limits. Refer to the following sources for important additional information:

In U.S.A.: 29 CFR 1910, ANSI Z49.1, American Welding Society, OSHA, U.S. Dept of Labor
In Canada: Canadian Standards Association, CAN/CSA - W17.2-M87
In UK: Current exposure limits under Health & Safety Executive EH40 are given in table 2.

PERSONAL PROTECTIVE EQUIPMENT

Skin Protection: Wear gloves, face protection and flame retardant clothing, do not expose skin to the heat, radiation and spatter from welding or spraying operations.

Eye Protection: Eye protection, to the appropriate national standard, is recommended when welding, cutting, spraying or grinding. Do not expose eyes to the heat and radiation from welding operations, use appropriate grade optical filters (welding glass) for welding or spraying process operations.

Respiratory Protection: Respiratory protection is necessary when exposure limits for airborne contaminants are exceeded during welding, grinding or cutting operations. Use air-supplied respirator in confined spaces.

In the USA, use only NIOSH-approved respirators in accordance with 29 CFR 1910.134, or other nationally approved respirators.

In the EU, if required use protection to EN136 (full face respirators), EN140 (half mask respirators), EN149 (filtered half masks (disposable)) or other appropriate EN standard. In the rest of the world use respiratory protection to the appropriate national standard.

Additional Recommendations: Source of running water to wash skin and eyes

Wear ear protection to the appropriate national standards where high levels of noise are experienced.

Exposure Guidelines See Appendix 1

9. PHYSICAL AND CHEMICAL PROPERTIES

	Filler Metal, Weld Strip and Thermal Spray Wire	Welding Electrode	Flux Cored Wire	Flux
Appearance:	Grey to silver or bronze metal	Varies grey, black, brown coating with metallic silver inner	Metallic silver outer with flux core	Varies grey, brown, green particles
Physical State:	Solid	Solid	Solid	Solid (Powder)
Molecular Weight:	Mixture	Mixture	Mixture	Mixture
Chemical Formula:	Mixture	Mixture	Mixture	Mixture
Odor:	Odorless	Odorless	Odorless	Odorless
Specific Gravity (water = 1.0):	8 – 9	4-7	5 - 8	
Bulk Density				0.8 – 1.1
Solubility In Water (wt. %):	Insoluble	Insoluble	Insoluble	Insoluble
Melting Point:	> 2300F (1260 ºC)	> 1800F (>1000°C)	> 1800F (>1000°C)	> 1800F (>1000°C)
Flash Point	None	None	None	None

Other physical and chemical properties, e.g. as described in 91/155/EEC and in the Approved Code of Practice, ref. 11, have no safety implications in relation to these materials.

10. STABILITY AND REACTIVITY

These consumables are stable and no hazardous decomposition products are formed upon exposure to water or the atmosphere. Nickel can react with carbon monoxide in reducing atmospheres to form nickel carbonyl, an extremely toxic gas.

11. TOXICOLOGICAL INFORMATION

Nickel and cobalt are classified as Category 3 carcinogens. The exposure route of concern is inhalation.

As shipped, these complex alloys in massive form have no known toxicological properties other than causing allergic reactions in individuals sensitive to the metal(s) contained in the alloys. However, dust from flux or user-generated dusts and fumes may on contact with the skin or eyes produce mechanical irritation. Chronic exposures coupled with sweat could cause dermatitis (skin) or conjunctivitis (eyes).

Excessive inhalation of dust or user-generated fumes from welding or metal spraying may, depending on the specific features of the process used, pose a long-term health hazard. The International Agency for Research on Cancer (IARC) has concluded that welding fumes are possibly carcinogenic to humans.

The ingredients of fumes and gases generated in welding, metals spraying and grinding will depend on the base metal and the details of the specific process being used. Ingredients may include metals, metal oxides, chromates, fluorides, carbon monoxide, ozone, and oxides of nitrogen. Phosgene can be produced if chlorinated solvent vapors are present in user operations.

More detailed toxicological information is given in APPENDIX 1

Composition of typical welding fume given in table 3.1 – 3.7,

Contamination or surface preparations etc can affect the composition of the produced fume.

Metals Spraying - Many variations of process are available; refer to table 2.1 in association with guidance from equipment manufacturers for likely constituents of produced fume.

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:

Chromium	The International Agency for Research on Cancer (IARC) considers hexavalent chromium to be a carcinogen (lung, nasal) but does not have adequate evidence for chromium metal and trivalent chromium. Fumes have been associated with lung fibrosis.
Iron	Prolonged inhalation of iron oxide fumes can lead to siderosis, which presents as a benign pneumoconiosis.
Molybdenum	Repeated inhalation of fumes has caused kidney damage, respiratory irritation and liver damage in animals.
Nickel	Nickel metal is “reasonably anticipated to be a human carcinogen” (National Toxicology Program’s 10th Report). IARC states that nickel metal is possibly carcinogenic to humans. Epidemiological studies of workers exposed to nickel powders, dusts and fumes in the nickel alloy and stainless steel producing industries do not indicate a significant respiratory cancer hazard. Inhalation of nickel powder produced malignant tumors in rodent studies. Single intratracheal installations of nickel powder at levels close to the LD_{50} have caused malignancies in hamsters. Can cause skin sensitization in susceptible individuals through prolonged contact with skin.
Niobium	No data available.

12. ECOLOGICAL INFORMATION

As a solid metal object, Filler Metal products are not considered toxic to aquatic species.
Flux (being of mineral constituents) from flux coated electrodes, flux cored wire and flux may degrade over time.
Observe national and local standards for fume extraction systems

13. DISPOSAL CONSIDERATIONS

Unused consumable wastes are normally collected to recover metal values.
Dispose of fume, flux, slag, weld grinding residues, over-spray etc, from the work area, or from filters, in accordance with national, federal, state or local regulations. Refer to this MSDS, Table 3.1-3.7, for possible contents of collected fumes and other materials. These may be in the form of dust requiring special health precautions. Nickel is regulated in many countries as hazardous to the environment. Other metals may be regulated in specific jurisdictions. In UK most alloyed material would be regarded as special waste. Observe all National, State, and local environmental regulations.

Packaging - Dispose of by recycling

14. TRANSPORT INFORMATION

No special precautions are necessary for the transport of these materials.

15. REGULATORY INFORMATION

Classification and labelling requirements
Alloys containing less than 1% of nickel or cobalt are not classified as "dangerous for supply". Alloys containing more than 1% of either metal are classified as the metals themselves (see Section 3). However, in recognition of their essentially non-hazardous nature, these alloys in the massive form are not required to be labelled as hazardous.

Product Labeling - UK Manufacture

WARNING: PROTECT YOURSELF AND OTHERS. READ AND UNDERSTAND THIS LABEL. TAKE PRECAUTIONS WHEN WELDING. ASK FOR YOUR EMPLOYER'S SAFETY PRACTICES WHICH SHOULD BE BASED ON MANUFACTURER'S HAZARD DATA
Fumes and gases can be dangerous to your health. Arc rays can injure eyes and burn skin. Electric shock can kill. Read and understand the manufacturer's instructions and your employer's safety practices. Keep your head out of the fumes. Use enough ventilation or exhaust at the arc to keep fumes and gases from your breathing zone, and the general area. Wear correct eye, ear and body protection. Do not touch live electrical parts.

DO NOT REMOVE THIS LABEL

Product Labeling – USA Manufacture

PROTECT YOURSELF AND OTHERS – READ AND UNDERSTAND THIS LABEL – TAKE PRECAUTIONS WHEN WELDING – ASK FOR YOUR EMPLOYER'S SAFETY PRACTICES WHICH SHOULD BE BASED ON MANUFACTURERS HAZARD DATA AVAILABLE TO HIM

Fumes and gas as can be dangerous to your health. Arc rays can injure eyes and burn skin. Electric shock can kill. Read and understand the manufacturer's instructions and your employers' safety practices. Keep your head out of the fume. Use enough ventilation, exhaust at the arc or both, to keep fumes and gases from your breathing zone, and the general area. Wear correct eye ear and body protection. Do not touch live electrical parts. See WMA publication 236 hazards from welding fume available from the manufacturer.

DO NOT REMOVE THIS LABEL

- -

WARNING POSSIBLE CANCER HAZARD OR LUNG DAMAGE IF INHALED – MAY CAUSE ALLERGIC REACTION – MAY CONTAIN FLUORIDES

PROTECT YOURSELF AND OTHERS – before use, read and understand this label, the manufacturer's instructions, Material Safety Data Sheets [MSDS's], and your employer's safety practices, which should be based on the manufacturer's hazard data available to him. See American National Standard Z49.1, Safety in Welding and Cutting and OSHA Safety and Health Standards 29CFR1910.

FUMES AND GAS can be dangerous to your health. Skin sensitization, irritation of skin, eye and respiratory tract, neurological damage, or death can result from over exposure. Keep your head out of the fumes. Use ventilation, preferably local exhaust ventilation, adequate to keep the concentration of the fumes and gases below the exposure limits. Special attention to ventilation is required in confined, small or crowded spaces. If adequate ventilation is not available, wear appropriate respiratory protection. Wash skin after contact with dust or fumes.

Arc rays can injure eyes and burn skin. Electric shock can kill. Do not touch live electrical parts. Wear correct eye, ear and body protection

DO NOT REMOVE THIS LABEL

SARA SECTION 313 SUPPLIER NOTIFICATION:
Individual consumables covered by this MSDS may contain the following toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372: Chromium, Copper, Manganese, and Nickel. Refer to "Section 2" of this MSDS for the filler metal name and the percent by weight, and "Table 1" for the CAS Number for each chemical.

16. OTHER INFORMATION

Current Issue Date:	March, 2011
Previous Issue Date:	None
Changes to MSDS From Previous Issue Are Due To:	Change of format which includes additional information

MSDS prepared by Special Metals technical department in compliance with directive 91/115/EEC, 93/112/EEC and HSE (UK) Welding Information Sheet No.1 and is provided in good faith based upon the experience and knowledge of the company. It should not be taken as a guarantee of alloy properties for ordering these materials. Users should make their own assessment of workplace risks as required by other health and safety legislation

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3. EH Health and Safety Executive's publications (www.hse.gov.uk)
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9. The Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 No. 1689.
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12. European Norm - EN 1811.

Table 2.1
Nominal Composition (Weight %) Of
Filler Metal, Thermal Spray Wires and Weldstrips Covered By This MSDS

Trade Name	Al	Cr	Co	Cu	Fe	Mn	Mo	Ni	Nb	Si	Ti	W
DURANICKEL® 301 & 301TSW™	4	-	-	-	-	-	-	94	-	1	1	-
INCOLOY® 65	-	21	-	2	30	1	3	42	-	-	1	-
INCONEL® 52	<1	29	-	-	9	1	-	59	-	-	-	-
INCONEL® 52M™	1	30			9	1		57	1		1	
INCONEL® 53MD™	3	29	-	-	3	1	-	64	-	-	-	-
INCONEL® 601	1	23	-	1	14	1	-	61	-	-	-	-
INCONEL® 617	1	22	12		2	1	9	52		1		
INCONEL® 62 & 62T	-	16	-	-	8	1	-	74	3	-	-	-
INCONEL® 622	-	20	-	-	5	-	14	58	-	-	-	3
INCONEL® 625, 625T & 625TSW™	-	22	-	-	1	-	9	61	4	-	-	-
INCONEL® 718 & 718TSW™	-	19	-	-	19	-	3	53	5	-	1	-
INCONEL® 72 & 72TSW™	-	44	-	-		-	-	55	-	-	1	-
INCONEL® 8020 TSW	-	20	-	-	-	-	-	78	-	1	-	-
INCONEL® 8020M TSW	-	20	-	-	-	-	-	78	-	2	-	-
INCONEL® 82 & 82T	-	20	-	-	1	3	-	72	3	-	-	-
INCONEL® 92	-	16	-	-	7	2	-	71	1	-	3	-
INCO-WELD® 686CPT®	-	21	-	-	1	-	16	58	-	-	-	4
INCO-WELD® 725NDUR®	-	21	-	-	9	-	9	57	3	-	1	-
INCO-WELD® C-276 & C276TSW™	-	16	2	-	6	-	16	57	-	-	-	3
INCO-WELD® HX	-	22	2	-	19	-	9	47	-	-	-	1
MONEL® 400 TSW	-	-	-	32	1	1	-	67	-	-	-	-
MONEL® 60, 60N & 60TSW™	-	-	-	27	-	4	-	65	1	1	2	-
MONEL® 67 & 67N	-	-	-	68	1	1	-	31	-	1	-	-
NC 80/20	-	20	-	-	-	1	-	79	-	-	-	-
Nickel 200 TSW	-	-	-	-	-	-	-	99	-	-	-	-
Nickel 61 & 61N	-	-	-	-	-	-	-	96	-	-	3	-
NILO® 365					52			43	3		1	
NILO® CF36™	-	-	-	-	61	-	-	36	2	-	-	-
NILO® CF42™	-	-	-	-	56	-	-	42	2	-	-	-
NIMONIC® 263	1	20	20	-	-	-	6	51	-	-	2	-
NIMONIC® 86	-	25	-	-	-	-	10	65	-	-	-	-
NIMONIC® 90	2	20	17		-	-	-	60	-	-	3	-
NIMONIC® PE11	1	18	-	-	34	-	5	39	-	-	2	-
NIMONIC® PE16	1	17	-	-	34	-	3	44	-	-	1	-
NIMONIC® PK33	2	18	14	-	1	-	7	56	-	-	2	-
NI-ROD® 44	-	-	-	-	48	10	-	42	-	-	-	-
NI-ROD® 44HT™	-	7	-	-	37	11	-	43	1	-	-	-
NI-ROD® 55	-	-	-	-	44	-	-	55	-	-	-	-
NI-ROD® 99	-	-	-	-	-	-	-	99	-	-	-	-
UDIMET® L605		20	55					10				15
WASPALOY	1	19	13		2	1	4	59			3	

Table 2.2
Composition (Weight %)
Of Flux Coated Electrodes Covered By This MSDS

PRODUCT NAME	Al	Al_2O_3	$BaCO_3$	BaF_2	C	$CaCO_3$	CaF_2	Cr	Co	Cu	Fe	Fe_2O_3	K_2O	K_2SiO_3	Li_2Co_3	Mn	MnO	Mo	Nb	Ni	SiO_2	$NaAlF_6$	Na_2SiO_3	$SrCO_3$	Ti	TiO_2	W
INCOLOY® 135						5-10		15-40		1-5	15-40					1-5		1-5		30-60	0.1-1	5-10	1-5		1-5	1-5	
INCONEL® 112 & 112T						5-10		15-40			1-5							5-10	1-5	40-70	1-5	5-10	1-5			1-5	
INCONEL® 112AC						5-10		15-40			1-5		1-3	1-5				5-10	1-5	40-70	1-5	5-10	1-5			1-5	
INCONEL® 117						5-10		15-40	5-10		1-5					0.5-2		5-10		40-70	0-5-2	5-10	1-5			1-5	
INCONEL® 122						5-10	1-5	15-40			1-5							10-30		40-70	0.1-1	5-10	1-5			1-5	1-5
INCONEL® 152						1-5		10-30			5-10					1-5			1-5	40-70	0.1-1	5-10	1-5	1-5		1-5	
INCONEL® 182 & 182T						5-10		10-30			5-10					1-5	1-5		1-5	40-70	0.1-1	1-10	1-5		1-5	1-5	
INCO-WELD® 686CPT®		1-5				3-7		10-30										10-30		30-60			1-5			3-7	1-5
INCO-WELD® A						5-10		10-30			6-12					1-5		1-5	1-5	30-60	0.1-2	5-10	1-5			3-7	
INCO-WELD® B						5-10	3-7	10-30			7-13					1-5		1-5	1-5	30-60	0.1-2		1-5				
INCO-WELD® C		1-5				1-5		10-30			30-60		1-5			1-5				5-10	1-5	1-5	1-5			5-10	
INCO-WELD® C-276						1-5		10-30	1-5		3-7					1-5		10-30		30-60	0.1-1	5-10	1-5			5-10	1-5
INCO-WELD® G3								15-25	1-3		15-21							4-8		45-55	3-6	1-10	1-5				0-2
MONEL® 187 & 187N						5-10	1-5			40-70					0.7-0.9	1-5				15.40	1.5	5-10	1-5		1-5	1-5	
MONEL® 190 & 190N			1-5			1-5	1-5			15-40						1-5				40-70	1-5	5-10	1-5		1-5	1-5	
Nickel 141 & 141N		1-5				5-10														40-70	0.5-2	5-10	1-5		1-5		
NI-ROD®	1-5		0-1		1-5	1-5	1-5				1-5	1-5								60-100			1-5	7-13			
NI-ROD® 44			1-5	1-5	1-5	1-5				1-5	30-60					7-13				30-60				7-13			
NI-ROD® 55					1-5	1-5	1-5				30-60	1-5								30-60				7-13			
NI-ROD® 55X			1-5	1-5	1-5	1-5				1-5	30-60					1-5				30-60				5-10			
NI-ROD® 60			1-5	1-5	1-5	1-5					30-60									30-60				7-13			
NI-ROD® 99X			1-5	1-5	1-5	1-5				1-5	1-5					1-5				60-100							

Table 2.3
Composition Of Flux-Cored Welding Wires Covered By This MSDS

Weight %	Ca0	CaF_2	C	Cr	Fe	Mn	MnO	Mo	$NaAlF_6$	Na_2O	Nb	Ni	SiO_2	TiO_2	K_2ZrF_6	ZrO_2
INCO-CORED© 625 AP	1-5			15-20			1-5	5-10		1-5	1-5	50-60	0.1-0.5	5-10		
INCO-CORED© 625 DH	1-5			15-20			1-5	5-10		1-5	1-5	50-60	0.1-0.5	5-10		
INCO-CORED© 82 AP				15-20	1-5	1-5					1-5	57-63	0.1-0.5	5-10		
INCO-CORED© 82 DH				15-20	1-5	1-5	1-5			1-5	1-5	57-63	0.1-0.5	5-10	1-5	1-5
NI-ROD© FC55		7-13	1-5		30-60	1-5			1-5			30-60				

Table 2.4
Composition of Flux Covered By This MSDS

Product Name	Al_2O_3	CaF_2	CaO	Cr_2O_3	MgO	Mn	MnO	Nb	Ni	K_2SiO_3	K_2O	SiO_2	$NaAlF_6$	TiO_2	ZrO_2	K_2ZrF_6	NaF	Others	
INCOFLUX® 4		60-100			1-5			1-5	1-5	1-5			3-7		1-5				
INCOFLUX® 5		60-100					10-30			1-5		1-5	3-7						
INCOFLUX® 6	15-40	40-70			3-7				1-5	1-5			3-7	3-7					
INCOFLUX® 7	15-40	40-70				1-5				1-5			3-7		5-20			Fe_3O_4	1-5
INCOFLUX® 8		60-100					10-30			1-5		1-5	3-7					Fe_3O_4	1-5
INCOFLUX® 9	1-5	15-20	28-33		2-6							28-33			4-8				
INCOFLUX® 10			85-95															$CaTiO_3$	1-5
																		NiMg	1-5
INCOFLUX® ESS1	10-15	65-80	10-15	3-8	3-7	1-5		1-5	1-5		1-3	1-5				3-7		Cr	1-5
INCOFLUX® ESS2	5-10	65-80		3-8	3-7	2-7		1-5	1-5	1-5	1-5	2-7	2-7			1-6	1-6	Cr	1-5
INCOFLUX® ESS3	20-40	45-70										5-15							
INCOFLUX® ESS4	5-10	65-80		5-10	3-7	2-7		1-5	1-5		1-5	2-7					1-6	Cr	1-5
INCOFLUX® NT100	15-40	40-70			3-7				1-5	1-5			3-7	3-7					
INCOFLUX® NT110	30-70	10-40					0-20			5-20		0-10		0-10				Cu	0-5
																		Na_20	0-5
																		$Na_2Si_4O_9$	5-20
INCOFLUX® NT120	26-33	30-35				0-5	2-4	1-5	1-5			2-4		4-7	8-13		1-6	$CaSiO_3$	1-5
																		Cr	0-5
																		Fe	1-6
																		Mo	1-6
																		Na_2O	2-4
																		$Na_2Si_4O_9$	1-6
INCOFLUX® SAS1	30-70	10-40	0-10			0-5	0-5			5-20		0-10		0-10				$CaCO_3$	0-10
																		Na_2O	0-5
																		$Na_2Si_4O_9$	5-20
INCOFLUX® SAS2	35-45	35-45		2-8		5-10				1-5								$CaSiO_3$	5-15
																		Cr	2-6
																		$CaTiO_3$	5-15

Table 2.5 - Nominal Composition (Weight %) Of Stainless Steel Filler Metal Covered By This MSDS

Trade Name	Fe	Cr	Ni	Mo	Mn	Si
INCO-WELD© 308, 308H, 308L, 308LSi	61-68	19-22	9-11	<0.5	1-2.5	<1
INCO-WELD© 309, 309H, 309L, 309LSi	54-61	23-25	12-14	<0.8	1-2.5	<1
INCO-WELD© 309LMo	52-59	23-25	12-14	2-3	1-2.5	0.6-1
INCO-WELD© 310	43-51	25-28	20-23	<.8	1-2.5	.3-.7
INCO-WELD© 312	51-59	29-32	8-10.5	<0.8	1-2.5	.3-.7
INCO-WELD© 316, 316L	57-65	18-20	11-14	2-3	1-2.5	.3-.7
INCO-WELD© 316LSi	57-65	18-20	11-14	2-3	1-2.5	.6-1
INCO-WELD© 347	61-68	19-21.5	9-11	<.8	1-2.5	.3-.7

Table 2.6 - Nominal Composition (Weight %) Of Aluminum Filler Metal Covered By This MSDS

Trade Name	Al	Si	Mn	Mg
INCO-WELD© 1050	>99.8			
INCO-WELD© 1080	>99.5			
INCO-WELD© 4043	Bal	4.5-6		
INCO-WELD© 4047	Bal	11-13		
INCO-WELD© 5154	Bal			3-4
INCO-WELD© 5183	Bal			4.3-5.2
INCO-WELD© 5356	Bal			4.5-5.5
INCO-WELD© 5556	Bal			4.7-5.5

Trace impurities and minor addition material names not listed above may also appear.

Table 2.7 - Nominal Composition (Weight %) Of Copper Filler Metal Covered By This MSDS

Trade Name	Cu	Sn	Mn	Fe	Si	Ni	Al
INCO-WELD© AlBZ8							
INCO-WELD© CuSN-A	Bal	4-6					
INCO-WELD© C11	Bal	5.5-8					
INCO-WELD© Cu	>98	<1	<0.5		<0.5		
INCO-WELD© CuSi-A	Bal	<1	<1.5	<.5	2.8-4		
INCO-WELD© CuAl-A2	Bal			<1.5			8.5-11
INCO-WELD© CuAL8-NI2							

Table 3.1
Composition of Welding Fume for Filler Metal Wires Covered By This MSDS (Weight %)

	Si	Ti	Al	Fe	Mn	Ni	Cr	Mo	Nb	Cu	Co
INCOLOY® 65	0.2	0.6	0.2	23	0.4	39	19	2	<0.1	2.8	-
INCONEL® 617	0.2	.0.3	0.7	1	0.6	40	16	8	<0.1	0.4	8
INCONEL® 625, 625T & 625TSW™	0.1	0.2	0.2	0.3	0.2	49	17	9	2	<0.1	-
INCONEL® 718 & 718TSW™	<0.1	0.9	0.6	15	0.4	44	15	3	3	0.4	-
INCONEL® 82 & 82T	0.3	0.3	0.2	1	6	56	15	<0.1	1	<0.1	-
INCO-WELD® C-276 & C276TSW™	0.1	<0.1	1	14	3	28	10	11	<0.1	0.8	-
MONEL® 60, 60N & 60TSW™	0.3	2	<0.1	2	5	47	<0.1	<0.1	<0.14	24	-
MONEL® 67 & 67N	0.4	1	0.6	2	2	10	<0.1	<0.1	<0.1	64	-
NC 80/20	0.4	0.1	0.1	0.4	2	57	16	<0.1	<0.1	0.6	-
Nickel 61 & 61N	<0.1	2	0.1	0.2	0.7	69	<0.1	<0.1	<0.1	1.3	-
NIMONIC® 263	0.2	2	0.4	0.7	0.7	43	17	5	<0.1	<0.1	14
NIMONIC® 90	1	1	2	3	0.4	35	15	<0.1	<0.1	0.4	9
NIMONIC® PE11	0.7	1	1	24	1	30	15	2	<0.1	0.4	-
NI-ROD® 44	<0.1	0.3	0.2	32	16	30	<0.1	<0.1	<0.1	<0.1	-
NI-ROD® 55	0.8	<0.1	0.1	33	4	31	<0.1	<0.1	<0.1	<0.1	-

Table 3.2
Composition of Welding Fume for Flux Coated Welding Electrodes Covered By This MSDS (Weight %)

	Ni	Cr Total	Cr 6	Fe	Mn	Cu	Co	Ti	Ba	F
INCOLOY® 135	0.88	3.13	0.91	2.15	2.99	0.60	0.02	3.51	<0.1	21.3
INCONEL® 112 & 112T	1.95	2.80	0.79	0.76	0.16	0.06	0.03	2.58	<0.1	26.7
INCONEL® 117	2.32	3.14	0.93	0.54	0.84	0.03	0.91	1.05	<0.1	28.4
INCONEL® 182 & 182T	1.59	2.14	0.55	0.94	10.5	0.06	0.03	3.29	<0.1	23.2
INCO-WELD® A	2.10	2.33	0.61	1.00	1.62	0.03	0.03	0.23	0.90	29.3
INCO-WELD® B	4.18	3.70	1.1	2.62	3.80	0.15	0.03	0.22	<0.1	20.9
INCO-WELD® C	0.77	4.38	1.49	9.62	3.19	0.09	0.20	2.91	<0.1	11.6
INCO-WELD® C-276	5.0	4.0	2.7	2.0	2.0	0.2	-	3.0	<0.1	-
MONEL® 187 & 187N	0.76	0.02	<0.01	0.42	2.33	10.7	0.03	3.36	2.90	30.4
MONEL® 190 & 190N	1.79	0.04	<0.01	0.26	2.43	8.7	0.04	1.23	1.83	24.9
Nickel 141 & 141N	3.15	0.02	<0.01	.56	.60	0.02	0.03	1.91	<0.01	30.2
NI-ROD©	13.9	0.01	0.01	3.77	0.27	0.02	0.05	0.64	<0.1	8.4
NI-ROD® 44	2.41	0.03	0.01	9.73	11.8	1.40	0.02	0.13	7.25	3.4
NI-ROD® 55	2.1	0.03	0.01	1.45	0.37	0.02	0.02	0.23	0.49	3.1
NI-ROD® 55X	1.23	0.02	<0.01	5.30	1.14	1.40	0.03	0.10	9.88	3.0
NI-ROD® 99X	3.23	0.03	<0.01	3.21	3.69	1.29	0.04	0.03	8.30	5

Table 3.3
Composition of Welding Fume for Flux-Cored Welding Wires Covered By This MSDS (Weight %)

	Si	Ti	Al	Fe	Mn	Ni	Cr	Mo	Nb	Cu
NI-ROD© FC55	1	0.3	3	13	7	13	<0.1	<0.1	<0.1	0.2

Table 3.4
Composition of Welding Fume for Stainless Steel Welding Wires Covered By This MSDS (Weight %)

	Fe	Mn	Ni	Cr	Cu	Mo
INCO-WELD© 308, 308H, 308L, 308LSi	40.30	4.10	6.30	11.10	0.16	0.06
INCO-WELD© 309, 309H, 309L, 309LSi	33.50	7.00	7.00	16.30	0.16	0.33
INCO-WELD© 310	34.50	4.20	10.00	16.50	0.16	0.06
INCO-WELD© 312	34.00	7.10	6.20	18.50	0.10	0.06
INCO-WELD© 316, 316L, 316LSi	31.00	7.10	6.50	8.50	0.70	1.80
INCO-WELD© 347	34.5	5.70	6.20	10.20	0.17	0.14
318	31.00	7	6.5	9	0.16	1.8
410	35	3		5.5		
18/8/Mn	40.3	8.20	6.20	11.20	0.15	1.06

Table 3.5
Composition of Welding Fume For Low Alloy Steel Welding Wires Covered By This MSDS (Weight %)

	Fe	Mn	Ni	Cr	Cu	Pb
A15 / A18	55	6.5			1.1	
A31	62	16			1.5	
A32	55	9	0.2	1.5	2	03
A33	53	6	0.3	2	2.2	0.5

Table 3.6
Composition of Welding Fume for Aluminum Alloy Welding Wires Covered By This MSDS

	Fe	Mn	Ni	Cr	Cu	Al_2O_3
INCO-WELD© 1050	1	0.1			0.2	90
INCO-WELD© 4043	2	0.1			0.40	80
INCO-WELD© 4047	2	0.1			0.4	80
INCO-WELD© 5356	1	0.1			0.50	83
INCO-WELD© 5556	1	0.1			0.40	80

Table 3.7
Composition of Welding Fume for Copper Alloy Welding Wires Covered By This MSDS

	Fe	Mn	Ni	Cr	Cu
INCO-WELD© Cu	0.30	0.60	0.10	0.10	75
INCO-WELD© CuSi-A	0.20	1.00	0.20	0.10	73
INCO-WELD© C12	0.30	0.10	0.10	0.10	75
INCO-WELD© C13	2.00	0.10	0.20	0.10	80
INCO-WELD© C26	5.0	1.00	0.50	0.10	75

Appendix 1

INGREDIENTS, TOXICOLOGICAL AND EXPOSURE LIMIT INFORMATION

The following information is primarily directed to the ingredients of the complex alloys listed in table 2.1, 2.2, 2.3, 2.5, 2.6, and 2.7. Although it is the user's responsibility to assess end products, intermediates, or fugitive emissions arising out of the use of these alloys, information is also provided for common fume ingredients. *UK EH40 limits for the ingredients are shown in italics at the end of each section.*

Ingredient		EINECS Number	CAS Number	Exposure Limits[(1)]:	Comments
Symbol	Name				
Al	Aluminum		7429-90-5	TLV: 10 mg/m³ (Metal dust); 5 mg/m³ (Welding fumes) PEL: 15 mg/m³ (Total metal dust); 5 mg/m³ (Metal dust – respirable fraction) LD_{50}: Not Available *EH40 - Aluminum metal: Total inhalable dust OES 10 mg/m³ (8 hours TWA),Total respirable dust OES 4 mg/m³ (8 hours TWA)*	Aluminum is not readily absorbed through the skin or the GI tract and only poorly through the lungs. Foreign literature between 1958 and 1962 reported cases of severe and sometimes fatal pulmonary fibrosis in workers exposed to aluminum dust. In one of the fatal cases, the worker developed fibrosis and encephalopathy after 13.5 years of exposure to aluminum dust. In rodent studies and currently in US industry, no fibrosis or encephalopathy have been reported from the inhalation of aluminum powder. Acute exposure to alumina fume may cause bronchial irritation; however reports of pulmonary fibrosis and emphysema in alumina abrasive workers are no longer seen, owing to improved environmental control.
Al_2O_3	Aluminum Oxide (Alumina)		1344-28-1	TLV: 10 mg/m³ PEL: 15 mg/m³ (Total dust); 5 mg/m³ (respirable) LD50: Not Available *EH40 Total inhalable dust OES 10 mg/m³ (8 hours TWA),Total respirable dust OES 4 mg/m³ (8 hours TWA)*	Acute exposure to this material may cause bronchial irritation; however reports of pulmonary fibrosis and emphysema of alumina abrasive workers are no longer seen, owing to improved environmental control.
$BaCO_3$	Barium Carbonate		513-77-9	TLV: 0.5 mg/m³ (Soluble compounds, as Ba) PEL: 0.5 mg/m³ (Soluble compounds, as Ba) LD50: 418 mg/kg, rat, oral *EH40 OES 0.5 mg/m³ (soluble compounds, as Ba)*	Excessive inhalation can produce a benign pneumoconiosis called Baritosis. Ingestion can cause excessive salivation, vomiting, colic, violent diarrhea, convulsive tremors progressing to muscular paralysis, increased blood pressure, internal hemorrhages in the kidneys and G.I tract, and possible hypokalemia.
BaF_2	Barium Flouride		7787-32-8	TLV: 0.5 mg/m³ (Soluble compounds, as Ba) PEL: 0.5 mg/m³ (Soluble compounds, as Ba) LD50: 250 mg/kg, rat, oral *EH40 OES 0.5 mg/m³ (soluble compounds, as Ba)*	Inhalation may cause irritation of the respiratory tract. Ingestion can cause severe gastrointestinal distress with vomiting, diarrhea, and abdominal pain. Barium and fluoride absorption can result in muscle (including cardiac) and nerve irregularities with potassium and calcium deficiencies. Chronic exposures may cause Fluorosis (Chronic fluoride intoxication) with symptoms of digestive disturbances such as vomiting, loss of appetite, diarrhea, or constipation.
C	Carbon		7440-44-0	TLV: 3.5 mg/m³ (As carbon black) PEL: 3.5 mg/m³ (As carbon black) LD50: 440 mg/kg, mouse, intravenous	Inhalation that is prolonged and repeated at excessive levels may lead to benign pneumoconiosis. No effects have been found for ingestion.
$CaCO_3$	Calcium Carbonate		1317-65-3	TLV: 10 mg/m³ PEL: 15 mg/m³ (Total dust); 5 mg/ m³ (Respirable fraction) LD50: 6,450 mg/kg, rat, oral *EH40: Total inhalable dust OES 10 mg/m³ (8 hours TWA),Total respirable dust OES 4 mg/m³ (8 hours TWA)*	This compound is considered non-toxic. Inhalation of particulates could cause mild irritation of the respiratory tract. Though used as an antacid, ingestion of large amounts could lead to intestinal blockage.

CaF_2	Calcium Fluoride (Fluorspar)		7789-75-5	TLV: 2.5 mg/m³ (as F) PEL: 2.5mg/m³ (as F) LD_{50}: 4,250mg/kg, rat, oral	Inhalation of welding fumes containing calcium fluoride can cause irritation of the respiratory tract. Ingestion of soluble fluorides can produce symptoms of vomiting, abdominal pain, diarrhea, convulsions, muscular weakness and other signs of neurological problems. Chronic exposures may cause Fluorosis (Chronic fluoride intoxication) with symptoms of digestive disturbances such as vomiting, loss of appetite, diarrhea, or constipation.
CaO	Calcium Oxide		1305-78-8	TLV: 2 mg/m³, as Calcium Oxide PEL: 5 mg/m³, as Calcium Oxide LD50: Not Known *EH40: Total inhalable dust OES 2 mg/m³ (8 hours TWA*	May cause skin, eye and mucous membrane irritation. Inhalation of dust or fume may cause respiratory irritation. Repeated exposure can cause damage to the nasal septum, pneumonia and dermatitis.
$CaSiO_3$	Calcium Metasilicate		1344-95-2	TLV: 10 mg/m³ (Dust) PEL: 15 mg/m³ (Total dust) 5 mg/m³ (Respirable) LD_{50}: Not Available *EH40: Total inhalable dust OES 10 mg/m³ (8 hours TWA),Total respirable dust OES 4 mg/m³ (8 hours TWA)*	Long Term cumulative inhalation of calcium metasilicate may cause restriction of the large airways. May cause minor skin and eye irritation. The International Agency for Research on Cancer (IARC) has concluded that calcium metasilicate is a questionable carcinogen with experimental tumorigenic data in animals. Not classifiable as a human carcinogen according to IARC.
Co	Cobalt	231-158-0	7440-48-4	TLV: 0.02 mg/m³ (Dust & fume as Co) PEL: 0.1 mg/m³ (As Co metal) LD_{50}: 6,170 mg/kg, rat, oral *EH40 OES 0.1 mg/m³ (8 hours TWA)*	Asthmatic symptoms and pulmonary fibrosis occurring in the tungsten carbide industry may be related to the inhalation of metallic cobalt dust. Evidence of polycythemia (an increase in the total red cell mass of the blood in the body) and altered thyroid, kidney and liver function have also been found. Excessive inhalation of metallic cobalt has produced cardiac changes in miniature swine. Eye contact may cause conjunctivitis. Symptoms of excessive ingestion may be a sensation of hotness with vomiting, diarrhea and nausea along with the potential for causing damage to blood, heart, thyroid and pancreas. Repeated skin contact can cause sensitivity and allergic skin rashes. Cobalt powders have caused tumors at the site of injection in rodents. However, studies of cobalt-containing prostheses do not suggest a significant risk for humans.
Cr	Chromium	231-157-5	7440-47-3	TLV: 0.5 mg/m³ PEL: 1.0 mg/m³ (Metal as Cr) LD_{50}: Not Available *EH40:* *Chromium VI compounds (as Cr)* *OES 0.05 mg/m³ (8 hours TWA)* *Chromium II compounds (as Cr)* *OES 0.5 mg/m³ (8 hours TWA)* *Chromium III compounds (as Cr)* *OES 0.5 mg/m³ (8 hours TWA)* *Chromium* *OES 0.5 mg/m³ (8 hours TWA)*	Chromium metal is relatively nontoxic. Chromium metal and insoluble salts are said to be involved in fibrosis of the lungs. When the metal is heated to a high temperature, fumes produced may be damaging to the lungs if inhaled. The International Agency for Research on Cancer has concluded that the evidence for carcinogenicity in humans and animals is inadequate for chromium metal and trivalent chromium compounds, but sufficient for hexavalent chromium compounds. Fumes from welding chromium-containing stainless steel or certain chromium-containing rods can trigger eczematous eruptions on the palms of the hands of chromium-sensitized individuals.
Cr_2O_3	Chromic Oxide		1308-38-9	TLV: 0.5 mg/m³, as Cr PEL: 0.5 mg/m³ (Metal as Cr) LD50: Not Available	Trivalent chromium compounds (such as Cr2O3) are considered to exhibit a low degree of toxicity. Excessive concentrations of airborne dust may irritate the nose, throat, and respiratory tract. Prolonged overexposure may result in pulmonary changes. Skin and eye contact may cause irritation. The U.S. National Toxicology Program (NTP) has concluded that there is sufficient evidence that certain chromium compounds were carcinogenic to humans. However, the International Agency for Research on Cancer (IARC) has stated that there is inadequate evidence for carcinogenicity to humans or animals for trivalent chromium compounds.

Cu	Copper	231-159-6	7440-50-8	TLV: 1 mg/m³ (Dusts & mists, as Cu), 0.2 mg/m³ (Fume) PEL: 1 mg/m³ (Dusts & mists, as Cu), 0.1 mg/m³ (Fume as Cu) LD_{50}: 35 mg/kg, mouse, intraperitoneal *EH40: Fume OES 0.2 mg/m³ (8 hours TWA)* *Dusts & mists (as Cu) OES 1.0 mg/m³ (8 hours TWA), 2.0 mg/m³ (15 minute reference period)*	Copper metal dust and fume may be irritating to the respiratory tract. In user operations where copper fume is generated, inhalation of the fume can result in symptoms of "Metal Fume Fever" such as chills, fever and sweating. A few instances of allergic skin rashes have been reported in workers with skin exposure to metallic copper. In the eyes, copper metal as a foreign body can provoke an inflammatory reaction resulting in pus formation in the conjunctiva, cornea or sclera. Ingestion of copper metal may cause gastrointestinal upset. Wilson's disease can occur in certain individuals with a rare, inherited metabolic disorder characterized by retention of excessive amounts of copper in the liver, brain, kidneys and corneas. These deposits eventually lead to tissue necrosis and fibrosis, causing a variety of clinical effects, especially liver disease and neurological changes. Wilson's disease is progressive and, if untreated, leads to fatal liver failure.
Fe/ Fe_2O_3	Iron	231-096-4	7439-89-6	TLV: No limit set (For Fe_2O_3 fume the TLV is 5 mg/m³ as Fe) PEL: No limit set (For Fe_2O_3 dust & fume the PEL is 10 mg/m³ as Fe) LD_{50}: Not Available *EH40 Iron Oxide, fume (as Fe) OES 5.0 mg/m³ (8 hours TWA), 10 mg/m³ (15 minute reference period)*	Inhalation of the excessive oxide fumes or dusts can lead to irritation of the respiratory tract. Prolonged inhalation of iron oxide for periods of 6 to 10 years is known to cause siderosis which appears to be a benign pneumoconiosis. Prolonged eye contact with the metal dust could cause rust brown colored spots forming around the particles and if left for several years, permanent damage could result.
Fe_3O_4	Ferrosoferric Oxide		1317-61-9	TLV: No limit set (For Fe_2O_3 fume, 5 mg/m_3 as Fe) PEL: No limit set (For Fe_2O_3 dust and fume, 5 mg/m³ as Fe) LD50: Not Available	Inhalation of excessive amounts can lead to irritation of the respiratory tract. Chronic inhalation of iron oxide for periods of 6 - 10 years is known to cause siderosis which seems to be a benign pneumoconiosis. No data found on ingestion.
K_2O	Potassium Oxide		12136-45-7	TLV: 2 mg/m³ Ceiling value as KOH PEL: 2 mg/m³ Ceiling value as KOH LD50: Not Available	No toxicity data was found on potassium oxide, but it is expected to have effects similar to sodium peroxide which is highly irritating to the skin, eyes and the mucous membranes of the respiratory tract.
K_2SiO_3	Potasium Silicate		1312-76-1	TLV: Not Established PEL: Not Established LD50: >1000 mg/kg, oral, rat	Silicates are generally considered to have low systemic toxicity, however due to their alkaline nature they may cause corrosive effects on mucous membranes. Eye exposure can cause irritation, redness, tearing and blurred vision. Prolonged eye exposure may lead to chronic conjunctivitis. Skin exposure may cause local slight irritation. Repeated contact may lead to dermatitis. Inhalation of mist or fume can cause irritation of the nasal and respiratory passages. Ingestion can produce gastrointestinal irritation, nausea, vomiting, diarrhea, accompanied by potentially severe tissue damage. No known chronic effects have been noted.
K_2ZrF_6	Potassium Fluozirconate		16923-95-8	TLV: 2.5 mg/m³ (Fluorides, as F) PEL: 2.5 mg/m³ (Fluorides, as F) LD50: 98 mg/kg, mouse, oral	Inhalation of welding fumes containing fluorides can cause irritation of the respiratory tract. Ingestion of soluble fluorides can produce symptoms of vomiting, abdominal pain, diarrhea, convulsions, muscular weakness and other signs of neurological problems. Nose bleeds, skin irritation, tissue damage and slow healing scars can result if exposure is excessive. Chronic exposures may cause Fluorosis (Chronic fluoride intoxication) with symptoms of digestive disturbances such as vomiting, loss of appetite, diarrhea, or constipation.

$LiCO_3$ Li_2CO_3	Lithium Carbonate		554-13-2	TLV: No limit set PEL: No limit set LD50: Oral 525 mg/kg, rat Dermal LD 50, > 2000 mg/kg, rat	Contact with skin or eyes may cause irritation. Ingestion may cause acute local tissue damage. Some studies of pregnant mice and rats indicated an association between lithium ingestion and birth defects but only at dose levels large enough to produce signs of severe maternal toxicity. Although data for the 1970's and early 1980's suggested an increase in cardiovascular defects in babies born to women on lithium carbonate therapy, more recent studies have not found any association between lithium exposure and birth defects. Exposure to lithium in industrial settings is not considered to pose a risk to human health. NIOSH studied 25 workers exposed to lithium-containing dust at air concentrations exceeding 10 Mg/M3 (nuisance dust limit) and found that typical industrial exposure to lithium will not result in blood levels sufficiently high to produce toxicity in either adults or their offspring.
MgO	Magnesium Oxide		1309-48-4	TLV: 10 mg/m³ (As fume) PEL: 15 mg/m³ (Total dust or fume) LD50: Not Available *EH40 Total inhalable dust OES 10 mg/m³ (8 hours TWA),Total fume and respirable dust OES 4 mg/m³ (8 hours TWA)*	Inhalation of fumes can irritate the nose and throat. Excessive inhalation can cause metal fume fever with flue-like symptoms such as fever, body aches, vomiting, etc. Fumes of magnesium may irritate the eyes and skin. On ingestion the oxide will act as an antacid and laxative.
Mn	Manganese	231-105-1	7439-96-5	TLV: 0.2 mg/m³ elemental and inorganic compounds, as Mn PEL: 5 mg/m³ (Ceiling, as Mn compounds); 5 mg/m³ (Fume, as Mn) LD_{50}: 9,000 mg/kg, rat, oral *EH40 Manganese and its inorganic compounds (as Mn) OES 0.5 mg/m³ (8 hours TWA)*	Excessive inhalation or ingestion of manganese can produce manganese poisoning. Chronic exposures can lead to neurological problems such as apathy, drowsiness, weakness, spastic gait, paralysis, and other neurological problems resembling Parkinsonism. These symptoms can become progressive and permanent if not treated. Excessive inhalation of fumes may cause "Metal Fume Fever" with its flu-like symptoms, such as chills, fever, body aches, vomiting, sweating, etc.
MnO	Manganous Oxide		1344-43-0	TLV: 0.2 mg/m³ (as Mn) PEL: 1mg/m³ (fume) 5mg/m³(Stel, Ceiling) LD_{50}: >50mg/kg, intratracheal rat.	Excessive inhalation or ingestion of manganese and manganese compounds can produce manganese poisoning. Chronic exposures can lead to neurological problems such as apathy, drowsiness, weakness, spastic gait, paralysis, and other neurological problems resembling Parkinsonism. These symptoms can become progressive and permanent if not treated. Inhalation of fumes may bring about "metal fume fever" with symptoms such as chills and fever, upset stomach, vomiting, dryness of throat, cough, weakness, and aching of the head and body.
Mo	Molybdenum	231-107-2	7439-96-7	TLV: 10 mg/m³ (Insoluble and metal compounds, as Mo) PEL: 15 mg/m³ (Insoluble compounds, total dust as Mo) LD_{50}: Not Available *EH40 - Molybdenum compounds (as Mo):* *Soluble - OES 5.0 mg/m³ (8 hours TWA), 10 mg/m³ (15 minute reference period)* *Insoluble - OES 10 mg/m³ (8 hours TWA), 20 mg/m³ (15 minute reference period)*	Molybdenum and its insoluble compounds are reported to have a low toxicity. High dietary intake may produce a gout-like disease and high blood uric acid. Inhalation of fumes has caused kidney damage, respiratory irritation and liver damage in animals. Skin and eye contact may cause irritation.

Na_20	Sodium Oxide		1313-59-3	TLV: 2 mg/m³ (ceiling level as NaOH) PEL: 2mg/m³ (as NaOH) LD_{50}: Not Available	Sodium oxide, in powder form, is highly corrosive to moist skin, eyes, and the mucous membranes of the digestive and respiratory tracts due to its reaction with water to form sodium hydroxide. Inhalation of dusts may cause symptoms that vary from mild irritation to destructive burns depending on exposure. Ingestion can cause immediate burning of the mouth, esophagus, and stomach; swelling of surround tissues, vomiting; and rapid, faint pulse with cold, clammy skin. Death can result. Skin contact causes slippery, soapy feeling that may not be immediately painful even though skin damage begins at contact. This contact can lead to chemical burns, tissue corrosion, ulceration, loss of nails and hair, and permanent scarring if not immediately washed off. The cornea of the eye will begin corroding on contact and can lead to temporary or permanent corneal opacification producing blindness. Chronic low level skin exposures to sodium hydroxide may result in dermatitis. Sodium hydroxide is reported to have caused carcinoma of the esophagus 12 to 42 years after ingestion.
$Na_2Si_4O_9$/ Na_2Si0_3	Sodium Silicate		1344-09-8	TLV: Not Established PEL: Not Established LD50: 1153 mg/kg, oral, rat	Silicates are generally considered to have low systemic toxicity, however due to their alkaline nature they may cause corrosive effects on mucous membranes. Eye exposure can cause severe irritation, redness, tearing and blurred vision. Skin exposure may cause slight irritation. Inhalation of mist or fume can cause irritation of the nasal and respiratory passages. Ingestion may produce gastrointestinal irritation, nausea, vomiting, diarrhea and abnormal kidney function. No known chronic effects have been noted.
Na_2AlF_6	Sodium Aluminum Fluoride (Sodium Fluoaluminate)		15096-52-3	TLV: No limit set PEL: No limit set LD50: 200 mg/kg, rat, oral	Excessive inhalation of dust may cause irritation of the nose, throat and respiratory tract. Ingestion causes severe gastrointestinal distress with salivation, nausea, vomiting, diarrhea, and pain. Also may cause muscular weakness, tremors, convulsions, loss of consciousness, and death. Prolonged exposure to fluorides can cause skeletal abnormalities and digestive tract disturbances. Prolonged or repeated skin contact can produce dermatitis.
NaF	Sodium Flouride		7681-49-4	TLV: 2.5 mg/m³ (as F) PEL: 2.5 mg/m³ (as F) LD_{50}: 0.18g/kg, rat, oral	Sodium fluoride is very poisonous. Ingestion of less than 1 gram can cause nausea and vomiting, salivation, diarrhea, weakness, spasms of limbs, and stupor. Ingestion of 5 to 10 grams has proven fatal. Symptoms of possible lethal exposure include muscular weakness, tremors, convulsions, collapse, and difficulty breathing to respiratory and cardiac failure. This chemical is irritating to the eyes, nose and respiratory system. Long-term exposure can cause skeletal abnormalities (Fluorosis) to develop. This can include bone densification and calcification of certain ligaments along with stiffness of the spinal column. Mottling of tooth enamel is also possible.
Nb	Niobium	231-113-5	7440-03-1	TLV: No limit set PEL: No limit set LD_{50}: Not Available	Also known as Columbium (Cb), there is almost no information on the toxicity of this metal or its fumes. Russian medical literature has described early chest x-ray changes in welders and chemical workers handling niobium and tantalum, but no specific data has been found. It is expected that the metal dust and fumes could cause irritation to the skin, eyes and respiratory tract upon acute exposure.

Ni	Nickel R43	231-111-4	7440-02-0	TLV: 1.5 mg/m³ as metal (Inhalable Fraction) PEL: 1 mg/m³ for metal and insoluble compounds as Ni LD_{50}: >9,000 mg/kg, rat, oral *EH40 - Nickel and its inorganic compounds (except nickel carbonyl): Water soluble nickel compounds (as nickel) OES 0.1 mg/m³ (8hours TWA). Nickel & water in-soluble nickel compounds (as Ni) OES 0.5 mg/m³(8-hour TWA)*	The U.S. National Toxicology Program (NTP) 10th Report on Carcinogens has listed "metallic nickel" as "reasonably anticipated to be a human carcinogen" and "nickel compounds" as "known human carcinogens". "Nickel Alloys" were reviewed but not listed. The International Agency for Research on Cancer (IARC) concluded that nickel compounds were carcinogenic to humans and that metallic nickel is possibly carcinogenic to humans. Epidemiological studies of workers exposed to nickel powder and to dust and fume generated in the production of nickel alloys and of stainless steel have not indicated the presence of a significant respiratory cancer hazard. The inhalation of nickel powder has not resulted in an increased incidence of malignant tumors in rodents. Repeated intratracheal instillation of nickel powder produced an increased incidence of malignant lung tumors in rats, but did not produce an increased incidence in hamsters when administered at the maximum tolerated dose. However, single intratracheal instillations of nickel powder in hamsters at doses near the LD_{50} have produced an increased incidence of fibrosarcomas, mesotheliomas and rhabdomyosarcomas. Inhalation of nickel powder at concentrations 15 times the PEL irritated the respiratory tract in rodents. Nickel is a known sensitizer and may produce allergic reactions.
Si	Silicon	231-130-8	7440-21-3	TLV: 10 mg/m³ PEL: 10 mg/m³ Total dust; 5 mg/m³ Respirable fraction LD50: 3,160 mg/kg, rat, oral in amorphous form *EH40 Total inhalable dust OES 10 mg/m³ (8 hours TWA). Total respirable dust OES 4 mg/m³ (8 hours TWA).*	Silicon in dust form is considered a nuisance dust with no toxic effects when exposures are kept under control. However, like all dusts, high concentrations of silicon dust will cause some irritation to the nose and throat. Inhalation of crystalline silica (SiO2) over a long period of time can cause silicosis. In 1997, the International Agency for Research on Cancer (IARC) concluded that crystalline silica is a class I carcinogen. IARC states that a number of studies have shown that persons diagnosed as having silicosis have an increased risk of dying from lung cancer.
SiO_2	Silicon Dioxide Silica		60676-86-0	TLV: 10 mg/m³ (Metal dust); 5 mg/m³ (Welding fumes) PEL: 15 mg/m³ (Total metal dust); 5 mg/m³ (Metal dust - respirable fraction) LD_{50}: Not Available *EH40: Silica, fused respirable dust, OES 0.08 mg/m³ (8-hour TWA)*	No information was found on the hazards of ingestion of crystalline silica as the material seems to be relatively inert. Acute exposures to this material will irritate the respiratory tract. Chronic inhalation (after 10 - 20 years) can produce silicosis pneumoconiosis of the lungs) with symptoms of dyspnea, cough, wheezing and repeated, non-specific chest illnesses. Impairment of pulmonary function may be progressive. In 1997, the International Agency for Research on Cancer (IARC) concluded that crystalline silica is a class 1 carcinogen. IARC states that a number of studies have shown that persons diagnosed as having silicosis have an increased risk of dying from lung cancer.
$SrCO_3$	Strontium Carbonate		1633-05-2	TLV: No limit set PEL: No limit set LD50: Not Available	There is very little toxicity and health data on this material. Excessive overexposure to the dust may ulcerate mucous membranes in the nose and may cause sneezing and coughing. No data found on ingestion problems.
Ti	Titanium	231-142-3	7440-32-6	TLV: No limit set PEL: No limit set LD_{50}: Not Available *EH40 - As Titanium dioxide: Total inhalable dust OES 10 mg/m³ (8 hours TWA), Total respirable dust OES 4 mg/m³ (8 hours TWA)*	Inhalation of titanium could cause mild irritation to the respiratory tract. Inhalation of titanium dioxide dust or fume could produce lung fibrosis and chronic bronchitis.

Ta	Tantalum		7440-25-7	TLV: 5 mg/m³ (Metal & oxide dusts) PEL: 5 mg/m³ (Metal & oxide dusts) LD_{50}: Not Available *EH40 OES 5.0 mg/m³ (8 hours TWA), 10 mg/m³ (15 minute reference period)*	There are no reports of adverse health effects in industrially exposed workers. Massive doses of tantalum given by the intratracheal route to rats have produced respiratory tract lesions. In contact with tissue, metallic tantalum is inert. Tantalum pentoxide has an LD_{50} of >8 g/kg, orally in rats.
TiO_2	Titanium Dioxide		13463-67-7	TLV: 10 mg/m³ (Dust); PEL: 5 mg/m³ (Respirable) LD_{50}: Not Available *EH40: Total inhalable dust OES 10.0 mg/m³(8-hour TWA), total respirable OES 4 mg/m³*	Is considered a nuisance dust that is inert, practically non-toxic and chemically non-irritating. Skin contact has shown no problems other than possible drying and mechanical abrasion. Eye contact can produce particulate irritation. Does not seem to be absorbed by the body through ingestion. Excessive inhalation can produce mild pulmonary irritation and possible non-disabling slight fibrosis of the lungs.
W	Tungsten	231-143-9	7440-33-7	TLV: 5 mg/m³ insoluble compounds, as W STEL: 10 mg/m³ for soluble compounds, as W PEL: No limit set LD_{50}: 2,000mg/kg, rat, unreported route *EH40: Soluble compounds, OES 1.0 mg/m³ (8-hour TWA) and 3 mg/m³ (15 minute reference period).* *In-soluble compounds, OES 5 mg/m³(8-hour TWA) and 10.0 mg/m3 (15 minutes reference period)*	Inhalation of tungsten dust may cause irritation of the respiratory tract. Skin or eye contact could cause abrasion or irritation of the respective surfaces. No hazards have been identified for tungsten fume except that it may aggravate an existing chronic respiratory disease.
$Zr0_2$	Zirconium Dioxide		1314-23-4	TLV: 5 mg/m³ (as Zr) 10 mg/m³ (STEL) PEL: 5 mg/m³ (as Zr) 10 mg/m³ (STEL) LD_{50}: Not Available *EH40 Zirconium compounds (as Zr), OES 5mg/m³ (8-hour TWA), 10 mg/m³ (15-minute reference period*	Though this material has a low order of toxicity on inhalation some lung granulomas have been reported. Excessive inhalation may cause irritation of the nose and respiratory tract. Eye contact may cause irritation. Skin contact may cause irritation and sensitization dermatitis characterized by dusty red-brown papules. No information found on effects of ingestion.

Notes: (1) TLV = Threshold Limit Values - American Conference of Governmental Industrial Hygienists
PEL = Permissible Exposure Limit - OSHA 29 CFR 1910.1000
C = Ceiling value
STEL = Short Term Exposure Limit - a time-weighted 15-minute exposure limit, not to be exceeded at any time during a workday.

(2) CAS No. = Chemical Abstracts Services Number

Trace impurities and additional material names not listed above may also appear in Appendix 1 toward the end of the MSDS. These materials may be listed for local “Right-To-Know” compliance and for other reasons.

Weight percentages for each grade of product are listed in Table 2.x

Buffer Solution pH 4.00

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 07/19/2013 Revision date: 12/21/2016 Supersedes: 08/06/2014 Version: 1.3

SECTION 1: Identification

1.1. Identification

Product form : Mixture

Product name : Buffer Solution pH 4.00

Product code : LC12270

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : For laboratory and manufacturing use only.

Recommended use : Laboratory chemicals

Restrictions on use : Not for food, drug or household use

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Not classified

2.2. Label elements

Not classified as a hazardous chemical.

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Name	Product identifier	%	GHS-US classification
Water	(CAS No) 7732-18-5	98.94	Not classified
Potassium Hydrogen Phthalate	(CAS No) 877-24-7	1.02	Eye Irrit. 2B, H320
Formaldehyde, 37% w/w	(CAS No) 50-00-0	0.04	Flam. Liq. 3, H226 Acute Tox. 4 (Oral), H302 Acute Tox. 4 (Dermal), H312 Acute Tox. 2 (Inhalation:vapour), H330 Skin Corr. 1C, H314 Eye Dam. 1, H318 Carc. 1A, H350 STOT SE 1, H370 Aquatic Acute 2, H401

Full text of hazard classes and H-statements : see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

First-aid measures after inhalation : Allow victim to breathe fresh air. Allow the victim to rest.

First-aid measures after skin contact : Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse.

First-aid measures after eye contact : Rinse immediately with plenty of water. Obtain medical attention if pain, blinking or redness persist.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : Not expected to present a significant hazard under anticipated conditions of normal use.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Reactivity : None.

5.3. Advice for firefighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment : Safety glasses.

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor.

Hygiene measures : Do not eat, drink or smoke when using this product.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep container closed when not in use.

Incompatible products : Strong oxidizers.

Incompatible materials : None known.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Potassium Hydrogen Phthalate (877-24-7)
Not applicable

Formaldehyde, 37% w/w (50-00-0)		
ACGIH	ACGIH Ceiling (mg/m³)	0.37 mg/m³
OSHA	OSHA PEL (TWA) (ppm)	0.75 ppm
OSHA	OSHA PEL (STEL) (ppm)	2 ppm
IDLH	US IDLH (ppm)	20 ppm
NIOSH	NIOSH REL (TWA) (ppm)	0.016 ppm
NIOSH	NIOSH REL (ceiling) (ppm)	0.1 ppm 15 min.

Water (7732-18-5)
Not applicable

8.2. Exposure controls

Appropriate engineering controls : Emergency eye wash fountains should be available in the immediate vicinity of any potential exposure.

Personal protective equipment : Safety glasses. Gloves.

Hand protection : Wear protective gloves.

Eye protection : Chemical goggles or safety glasses.

Respiratory protection : Respiratory protection not required in normal conditions.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Color : Colorless

Odor : Odorless

Odor threshold : No data available

pH : 4

Melting point : No data available

Freezing point : No data available

Boiling point : No data available

Flash point : No data available

Relative evaporation rate (butyl acetate=1) : No data available

Flammability (solid, gas) : Non flammable.

Vapor pressure : No data available

Relative vapor density at 20 °C : No data available

Relative density : No data available

Specific gravity / density : 1

Solubility : Soluble in water.

Log Pow : No data available

Auto-ignition temperature : No data available

Decomposition temperature : No data available

Viscosity, kinematic : No data available

Viscosity, dynamic : No data available

Explosion limits : No data available

Explosive properties : Not applicable.

Oxidizing properties : None.

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

None.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

None.

10.4. Conditions to avoid

Extremely high or low temperatures.

10.5. Incompatible materials

Strong oxidizers.

10.6. Hazardous decomposition products

Formaldehyde. Carbon monoxide. Carbon dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure : Skin and eye contact

Acute toxicity : Not classified

Potassium Hydrogen Phthalate (877-24-7)	
LD50 oral rat	≥ 3200 mg/kg
ATE US (oral)	3200.000 mg/kg body weight

Formaldehyde, 37% w/w (50-00-0)	
LD50 oral rat	500 mg/kg
ATE US (oral)	500.000 mg/kg body weight
ATE US (dermal)	2000.000 mg/kg body weight
ATE US (vapors)	0.578 mg/l/4h

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg
ATE US (oral)	90000.000 mg/kg body weight

Skin corrosion/irritation : Not classified
pH: 4

Serious eye damage/irritation : Not classified
pH: 4

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Formaldehyde, 37% w/w (50-00-0)	
IARC group	1 - Carcinogenic to humans

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

Potential Adverse human health effects and symptoms : Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1. Toxicity

Formaldehyde, 37% w/w (50-00-0)	
LC50 fish 1	41 mg/l (LC50; 96 h)
EC50 Daphnia 1	14.7 mg/l (EC50; 24 h)
EC50 Daphnia 2	2 mg/l
Threshold limit algae 1	2.5 mg/l (EC0; 192 h)

12.2. Persistence and degradability

Buffer Solution pH 4.00	
Persistence and degradability	Not established.

Potassium Hydrogen Phthalate (877-24-7)	
Persistence and degradability	Not established.

Formaldehyde, 37% w/w (50-00-0)	
Persistence and degradability	Readily biodegradable in water. Biodegradability in soil: no data available. No test data on mobility of the components available. Photodegradation in the air.
Biochemical oxygen demand (BOD)	0.64 g O_2/g substance
Chemical oxygen demand (COD)	1.06 g O_2/g substance
ThOD	1.068 g O_2/g substance
BOD (% of ThOD)	0.6 (5 days; Literature study)

Water (7732-18-5)	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

Buffer Solution pH 4.00	
Bioaccumulative potential	Not established.

Potassium Hydrogen Phthalate (877-24-7)	
Bioaccumulative potential	Not established.

Formaldehyde, 37% w/w (50-00-0)	
Log Pow	-0.78 - 0.0
Bioaccumulative potential	Bioaccumulation: not applicable.

Water (7732-18-5)	
Bioaccumulative potential	Not established.

12.4. Mobility in soil

Formaldehyde, 37% w/w (50-00-0)	
Ecology - soil	Toxic to flora.

12.5. Other adverse effects

Effect on the global warming : No known effects from this product.

GWPmix comment : No known effects from this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Not regulated

SECTION 15: Regulatory information

15.1. US Federal regulations

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Formaldehyde, 37% w/w (50-00-0)	
RQ (Reportable quantity, section 304 of EPA's List of Lists)	100 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard Delayed (chronic) health hazard
SARA Section 313 - Emission Reporting	0.1 %

15.2. International regulations

CANADA

Buffer Solution pH 4.00	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

Potassium Hydrogen Phthalate (877-24-7)	
WHMIS Classification	Class D Division 2 Subdivision B - Toxic material causing other toxic effects

Formaldehyde, 37% w/w (50-00-0)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class B Division 3 - Combustible Liquid Class D Division 1 Subdivision A - Very toxic material causing immediate and serious toxic effects Class D Division 2 Subdivision A - Very toxic material causing other toxic effects Class D Division 2 Subdivision B - Toxic material causing other toxic effects Class E - Corrosive Material

Water (7732-18-5)	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

EU-Regulations

No additional information available

National regulations

Formaldehyde, 37% w/w (50-00-0)
Listed on the Canadian IDL (Ingredient Disclosure List)

15.3. US State regulations

California Proposition 65 - This product contains, or may contain, trace quantities of a substance(s) known to the state of California to cause cancer, developmental and/or reproductive harm

Formaldehyde, 37% w/w (50-00-0)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	Non-significant risk level (NSRL)
Yes	Yes	No	No	40 µg/day

SECTION 16: Other information

Revision date : 12/21/2016

Other information : None.

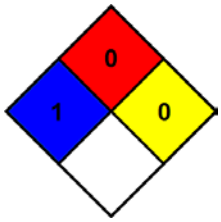
Full text of H-phrases: see section 16:

H226	Flammable liquid and vapor
H302	Harmful if swallowed
H312	Harmful in contact with skin
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H320	Causes eye irritation
H330	Fatal if inhaled
H350	May cause cancer
H370	Causes damage to organs
H401	Toxic to aquatic life

NFPA health hazard : 1 - Exposure could cause irritation but only minor residual injury even if no treatment is given.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 1 Slight Hazard - Irritation or minor reversible injury possible

Flammability : 0 Minimal Hazard - Materials that will not burn

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

Personal protection : A

A - Safety glasses

SDS US LabChem

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

Buffer Solution pH 7.00

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 07/22/2013 Revision date: 12/22/2016 Supersedes: 07/22/2013 Version: 1.1

SECTION 1: Identification

1.1. Identification

Product form : Mixture

Product name : Buffer Solution pH 7.00

Product code : LC12370

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : For laboratory and manufacturing use only.

Recommended use : Laboratory chemicals

Restrictions on use : Not for food, drug or household use

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Not classified

2.2. Label elements

Not classified as a hazardous chemical.

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Name	Product identifier	%	GHS-US classification
Water	(CAS No) 7732-18-5	99.24	Not classified
Potassium Phosphate, Monobasic	(CAS No) 7778-77-0	0.68	Not classified
Sodium Hydroxide	(CAS No) 1310-73-2	0.08	Acute Tox. 4 (Dermal), H312 Skin Corr. 1A, H314 Eye Dam. 1, H318 Aquatic Acute 3, H402

Full text of hazard classes and H-statements : see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

First-aid measures after inhalation : Allow victim to breathe fresh air. Allow the victim to rest.

First-aid measures after skin contact : Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse.

First-aid measures after eye contact : Rinse immediately with plenty of water. Obtain medical attention if pain, blinking or redness persist.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : Not expected to present a significant hazard under anticipated conditions of normal use.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

No additional information available

5.3. Advice for firefighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment : Safety glasses.

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep container closed when not in use.

Incompatible products : Strong oxidizers.

Incompatible materials : None known.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Potassium Phosphate, Monobasic (7778-77-0)
Not applicable

Sodium Hydroxide (1310-73-2)		
ACGIH	ACGIH Ceiling (mg/m³)	2 mg/m³ (Sodium hydroxide; USA; Momentary value; TLV - Adopted Value)
OSHA	OSHA PEL (TWA) (mg/m³)	2 mg/m³
IDLH	US IDLH (mg/m³)	10 mg/m³
NIOSH	NIOSH REL (ceiling) (mg/m³)	2 mg/m³

Water (7732-18-5)
Not applicable

8.2. Exposure controls

Personal protective equipment : Safety glasses.

Eye protection : Chemical goggles or safety glasses.

Respiratory protection : Respiratory protection not required in normal conditions.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Liquid
Appearance	: Clear, colorless liquid.
Color	: Colorless
Odor	: None.
Odor threshold	: No data available
pH	: 7
Melting point	: No data available
Freezing point	: No data available
Boiling point	: No data available
Flash point	: No data available
Relative evaporation rate (butyl acetate=1)	: No data available
Flammability (solid, gas)	: Non flammable.
Vapor pressure	: No data available
Relative vapor density at 20 °C	: No data available
Relative density	: No data available
Solubility	: Soluble in water.
Log Pow	: No data available
Auto-ignition temperature	: No data available
Decomposition temperature	: No data available
Viscosity, kinematic	: No data available
Viscosity, dynamic	: No data available
Explosion limits	: No data available
Explosive properties	: No data available
Oxidizing properties	: No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

Strong oxidizers.

10.6. Hazardous decomposition products

Phosphorus oxides. Sodium oxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure : Skin and eye contact

Acute toxicity : Not classified

Potassium Phosphate, Monobasic (7778-77-0)	
LD50 dermal rabbit	4640 mg/kg
ATE US (dermal)	4640.000 mg/kg body weight

Sodium Hydroxide (1310-73-2)	
ATE US (dermal)	1350.000 mg/kg body weight

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg
ATE US (oral)	90000.000 mg/kg body weight

Skin corrosion/irritation : Not classified
pH: 7

Serious eye damage/irritation : Not classified
pH: 7

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

Potential Adverse human health effects and symptoms : Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1. Toxicity

Sodium Hydroxide (1310-73-2)	
LC50 fish 1	45.4 mg/l (LC50; Other; 96 h; Salmo gairdneri; Static system; Fresh water; Experimental value)

12.2. Persistence and degradability

Buffer Solution pH 7.00	
Persistence and degradability	Not established.

Potassium Phosphate, Monobasic (7778-77-0)	
Persistence and degradability	Not established.

Sodium Hydroxide (1310-73-2)	
Persistence and degradability	Biodegradability: not applicable. No test data on mobility of the substance available.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable

Water (7732-18-5)	
Persistence and degradability	Not established.

12.3. Bioaccumulative potential

Buffer Solution pH 7.00	
Bioaccumulative potential	Not established.

Potassium Phosphate, Monobasic (7778-77-0)	
Bioaccumulative potential	Not established.

Sodium Hydroxide (1310-73-2)	
Bioaccumulative potential	No bioaccumulation data available.

Water (7732-18-5)	
Bioaccumulative potential	Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on the global warming : No known effects from this product.

GWPmix comment : No known effects from this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Not regulated

SECTION 15: Regulatory information

15.1. US Federal regulations

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Sodium Hydroxide (1310-73-2)	
RQ (Reportable quantity, section 304 of EPA's List of Lists)	1000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

15.2. International regulations

CANADA

Buffer Solution pH 7.00	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

Potassium Phosphate, Monobasic (7778-77-0)	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

Sodium Hydroxide (1310-73-2)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class E - Corrosive Material

Water (7732-18-5)	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

EU-Regulations
No additional information available

National regulations
No additional information available

15.3. US State regulations
California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

SECTION 16: Other information

Revision date : 12/22/2016

Other information : None.

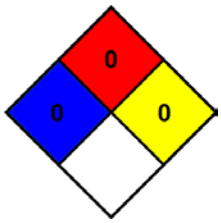
Full text of H-phrases: see section 16:

H312	Harmful in contact with skin
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H402	Harmful to aquatic life

NFPA health hazard : 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 0 Minimal Hazard - No significant risk to health

Flammability : 0 Minimal Hazard - Materials that will not burn

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

Personal protection : A

A - Safety glasses

SDS US LabChem

Information in this SDS is from available published sources and is believed to be accurate. No warranty, express or implied, is made and LabChem Inc assumes no liability resulting from the use of this SDS. The user must determine suitability of this information for his application.

Buffer Solution pH 10.00

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 12/09/2013 Revision date: 12/20/2016 Supersedes: 12/09/2013 Version: 1.1

SECTION 1: Identification

1.1. Identification

Product form : Mixture

Product name : Buffer Solution pH 10.00

Product code : LC12500

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : For laboratory and manufacturing use only.

1.3. Details of the supplier of the safety data sheet

LabChem Inc
Jackson's Pointe Commerce Park Building 1000, 1010 Jackson's Pointe Court
Zelienople, PA 16063 - USA
T 412-826-5230 - F 724-473-0647
info@labchem.com - www.labchem.com

1.4. Emergency telephone number

Emergency number : CHEMTREC: 1-800-424-9300 or 011-703-527-3887

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Reproductive toxicity Category 1B H360

Full text of H statements : see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS08

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) : H360 - May damage fertility or the unborn child

Precautionary statements (GHS-US) : P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P280 - Wear protective gloves, eye protection
P308+P313 - IF exposed or concerned: Get medical advice/attention
P405 - Store locked up
P501 - Dispose of contents/container to comply with local, state and federal regulations

2.3. Other hazards

Other hazards not contributing to the classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substance

Not applicable

3.2. Mixture

Name	Product identifier	%	GHS-US classification
Water	(CAS No) 7732-18-5	99.57	Not classified
Sodium Tetraborate, Decahydrate	(CAS No) 1303-96-4	0.38	Repr. 1B, H360
Sodium Hydroxide	(CAS No) 1310-73-2	0.05	Acute Tox. 4 (Dermal), H312 Skin Corr. 1A, H314 Eye Dam. 1, H318 Aquatic Acute 3, H402

Full text of hazard classes and H-statements : see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. IF exposed or concerned: Get medical advice/attention.

First-aid measures after inhalation : Allow victim to breathe fresh air. Allow the victim to rest.

First-aid measures after skin contact : Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse.

First-aid measures after eye contact : Rinse immediately with plenty of water. Obtain medical attention if pain, blinking or redness persist.

First-aid measures after ingestion : Rinse mouth. Do NOT induce vomiting. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries : May damage fertility or the unborn child.

4.3. Indication of any immediate medical attention and special treatment needed

No additional information available

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

No additional information available

5.3. Advice for firefighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment.

Protection during firefighting : Do not enter fire area without proper protective equipment, including respiratory protection.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. For non-emergency personnel

Protective equipment : Safety glasses. Gloves.

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Soak up spills with inert solids, such as clay or diatomaceous earth as soon as possible. Collect spillage. Store away from other materials.

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor. Do not handle until all safety precautions have been read and understood. Obtain special instructions before use.

Hygiene measures : Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions : Keep container closed when not in use.

Incompatible products : Strong oxidizers. Strong acids.

Incompatible materials : incompatible materials. Heat sources.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Sodium Tetraborate, Decahydrate (1303-96-4)		
ACGIH	ACGIH TWA (mg/m³)	2 mg/m³
ACGIH	ACGIH STEL (mg/m³)	6 mg/m³
NIOSH	NIOSH REL (TWA) (mg/m³)	5 mg/m³

Water (7732-18-5)
Not applicable

Sodium Hydroxide (1310-73-2)		
ACGIH	ACGIH Ceiling (mg/m³)	2 mg/m³ (Sodium hydroxide; USA; Momentary value; TLV - Adopted Value)
OSHA	OSHA PEL (TWA) (mg/m³)	2 mg/m³
IDLH	US IDLH (mg/m³)	10 mg/m³
NIOSH	NIOSH REL (ceiling) (mg/m³)	2 mg/m³

8.2. Exposure controls

Appropriate engineering controls : Emergency eye wash fountains should be available in the immediate vicinity of any potential exposure.

Personal protective equipment : Safety glasses. Gloves.

Hand protection : Wear protective gloves.

Eye protection : Chemical goggles or safety glasses.

Respiratory protection : Respiratory protection not required in normal conditions.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Color : Colorless

Odor : None.

Odor threshold : No data available

pH : 10

Melting point : No data available

Freezing point : No data available

Boiling point : No data available

Flash point : No data available

Relative evaporation rate (butyl acetate=1) : No data available

Flammability (solid, gas) : Non flammable.

Vapor pressure : No data available

Relative vapor density at 20 °C : No data available

Relative density : No data available

Solubility : Miscible with water.

Log Pow : No data available

Auto-ignition temperature : No data available

Decomposition temperature : No data available

Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available
Explosion limits	:	No data available
Explosive properties	:	No data available
Oxidizing properties	:	No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Not established.

10.4. Conditions to avoid

Incompatible materials. Extremely high or low temperatures.

10.5. Incompatible materials

Strong acids. Strong oxidizers.

10.6. Hazardous decomposition products

boron.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure	:	Skin and eye contact
Acute toxicity	:	Not classified

Sodium Tetraborate, Decahydrate (1303-96-4)	
LD50 oral rat	2660 mg/kg
LD50 dermal rabbit	10000 mg/kg
ATE US (oral)	2660.000 mg/kg body weight
ATE US (dermal)	10000.000 mg/kg body weight

Water (7732-18-5)	
LD50 oral rat	≥ 90000 mg/kg
ATE US (oral)	90000.000 mg/kg body weight

Sodium Hydroxide (1310-73-2)	
ATE US (dermal)	1350.000 mg/kg body weight

Skin corrosion/irritation	:	Not classified pH: 10
Serious eye damage/irritation	:	Not classified pH: 10
Respiratory or skin sensitization	:	Not classified
Germ cell mutagenicity	:	Not classified
Carcinogenicity	:	Not classified
Reproductive toxicity	:	May damage fertility or the unborn child.
Specific target organ toxicity (single exposure)	:	Not classified
Specific target organ toxicity (repeated exposure)	:	Not classified
Aspiration hazard	:	Not classified

Potential Adverse human health effects and symptoms : Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1. Toxicity

Sodium Tetraborate, Decahydrate (1303-96-4)	
EC50 Daphnia 1	1085 mg/l

Sodium Hydroxide (1310-73-2)	
LC50 fish 1	45.4 mg/l (LC50; Other; 96 h; Salmo gairdneri; Static system; Fresh water; Experimental value)

12.2. Persistence and degradability

Buffer Solution pH 10.00	
Persistence and degradability	Not established.

Sodium Tetraborate, Decahydrate (1303-96-4)	
Persistence and degradability	Not established.

Water (7732-18-5)	
Persistence and degradability	Not established.

Sodium Hydroxide (1310-73-2)	
Persistence and degradability	Biodegradability: not applicable. No test data on mobility of the substance available.
Biochemical oxygen demand (BOD)	Not applicable
Chemical oxygen demand (COD)	Not applicable
ThOD	Not applicable

12.3. Bioaccumulative potential

Buffer Solution pH 10.00	
Bioaccumulative potential	Not established.

Sodium Tetraborate, Decahydrate (1303-96-4)	
Bioaccumulative potential	Not established.

Water (7732-18-5)	
Bioaccumulative potential	Not established.

Sodium Hydroxide (1310-73-2)	
Bioaccumulative potential	No bioaccumulation data available.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Effect on the global warming : No known effects from this product.

GWPmix comment : No known effects from this product.

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose of contents/container to comply with local, state and federal regulations.

Ecology - waste materials : Avoid release to the environment.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Not regulated

SECTION 15: Regulatory information

15.1. US Federal regulations

Buffer Solution pH 10.00	
SARA Section 311/312 Hazard Classes	Delayed (chronic) health hazard

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Sodium Hydroxide (1310-73-2)	
RQ (Reportable quantity, section 304 of EPA's List of Lists)	1000 lb
SARA Section 311/312 Hazard Classes	Immediate (acute) health hazard

15.2. International regulations

CANADA

Buffer Solution pH 10.00	
WHMIS Classification	Class D Division 2 Subdivision A - Very toxic material causing other toxic effects

Sodium Tetraborate, Decahydrate (1303-96-4)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class D Division 2 Subdivision A - Very toxic material causing other toxic effects

Water (7732-18-5)	
WHMIS Classification	Uncontrolled product according to WHMIS classification criteria

Sodium Hydroxide (1310-73-2)	
Listed on the Canadian DSL (Domestic Substances List)	
WHMIS Classification	Class E - Corrosive Material

EU-Regulations

No additional information available

National regulations

Sodium Tetraborate, Decahydrate (1303-96-4)
Listed on the Canadian IDL (Ingredient Disclosure List)

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

SECTION 16: Other information

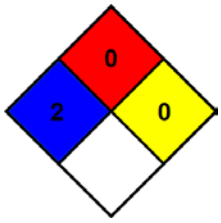
Revision date : 12/20/2016

Other information : None.

Full text of H-phrases: see section 16:

H312	Harmful in contact with skin
H314	Causes severe skin burns and eye damage
H318	Causes serious eye damage
H360	May damage fertility or the unborn child
H402	Harmful to aquatic life

NFPA health hazard	:	2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.
NFPA fire hazard	:	0 - Materials that will not burn.
NFPA reactivity	:	0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health	:	2 Moderate Hazard - Temporary or minor injury may occur
Flammability	:	0 Minimal Hazard - Materials that will not burn
Physical	:	0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.
Personal protection	:	B B - Safety glasses, Gloves

SDS US LabChem

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SAFETY DATA SHEET

1. Identification

Product identifier **LPS 3® (Bulk)**

Other means of identification

Part Number 00322, 03128, 00305, 00355

Recommended use A specialized soft-film coating designed to prevent rust and corrosion on steel, aluminum and other metals.

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer

Manufacturer

Company name ITW Pro Brands

Address 4647 Hugh Howell Rd.
Tucker, GA 30084

Country (U.S.A.)

Tel: +1 770-243-8800

In Case of Emergency 1-800-424-9300 (inside U.S.)
+001 703-527-3887 (outside U.S.)

Website www.lpslabs.com

E-mail lpssds@itwprobrands.com

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 3
Health hazards	Skin corrosion/irritation	Category 2
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
	Aspiration hazard	Category 1

Environmental hazards Not classified.

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Flammable liquid and vapor. Causes skin irritation. May cause drowsiness or dizziness. May be fatal if swallowed and enters airways.

Precautionary statement

Prevention Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing mist or vapor. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves/eye protection/face protection.

Response If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse. In case of fire: Use appropriate media to extinguish.

Storage Keep cool. Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
Distillates Petroleum Hydrotreated Light		64742-47-8	60 - 70
Distillates Petroleum Hydrotreated Heavy		64742-54-7	1 - 10
1-butoxy-2-propanol		5131-66-8	1 - 5
Calcium Carbonate		471-34-1	0.1 - 1
Hydrodesulferized Heavy Petroleum Naptha		64742-82-1	0.1 - 1
2-Methyl Butyl Acetate		624-41-9	< 0.1

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.
Skin contact	Take off immediately all contaminated clothing. Rinse skin with water/shower. If skin irritation occurs: Get medical advice/attention. Wash contaminated clothing before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Get medical attention if irritation develops and persists.
Ingestion	Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Most important symptoms/effects, acute and delayed	Aspiration may cause pulmonary edema and pneumonitis. May cause drowsiness and dizziness. Headache. Nausea, vomiting. Direct contact with eyes may cause temporary irritation. Skin irritation. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. Keep victim under observation. Symptoms may be delayed.
General information	Take off all contaminated clothing immediately. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Alcohol resistant foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Vapors may form explosive mixtures with air. Vapors may travel considerable distance to a source of ignition and flash back. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	Flammable liquid and vapor.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Wear appropriate protective equipment and clothing during clean-up. Avoid breathing mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Local authorities should be advised if significant spillages cannot be contained. Use personal protection recommended in Section 8 of the SDS.

Methods and materials for containment and cleaning up

Use water spray to reduce vapors or divert vapor cloud drift. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Keep combustibles (wood, paper, oil, etc.) away from spilled material. Take precautionary measures against static discharge. Use only non-sparking tools. The product is immiscible with water and will spread on the water surface.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Following product recovery, flush area with water.

Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.

Environmental precautions

Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling

Do not handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. When using do not smoke. Explosion-proof general and local exhaust ventilation. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. Avoid breathing mist or vapor. Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep away from heat, sparks and open flame. Prevent electrostatic charge build-up by using common bonding and grounding techniques. Store in a cool, dry place out of direct sunlight. Store in original tightly closed container. Store in a well-ventilated place. Keep in an area equipped with sprinklers. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

U.S. - OSHA

Components	Type	Value	Form
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)	PEL	5 mg/m3	Oil mist

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Xylene (CAS 1330-20-7)	PEL	435 mg/m3 100 ppm

ACGIH

Components	Type	Value	Form
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)	TWA	5 mg/m3	Oil mist

US. ACGIH Threshold Limit Values

Components	Type	Value
2-Methyl Butyl Acetate (CAS 624-41-9)	STEL	100 ppm
	TWA	50 ppm
Xylene (CAS 1330-20-7)	STEL	150 ppm
	TWA	100 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Calcium Carbonate (CAS 471-34-1)	TWA	5 mg/m3	Respirable.
		10 mg/m3	Total

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Xylene (CAS 1330-20-7)	1.5 g/g	Methylhippuric acids	Creatinine in urine	*

* - For sampling details, please see the source document.

Appropriate engineering controls Explosion-proof general and local exhaust ventilation. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Wear appropriate chemical resistant gloves. Suitable gloves can be recommended by the glove supplier.

Other Wear appropriate chemical resistant clothing.

Respiratory protection In case of insufficient ventilation, wear suitable respiratory equipment. Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using do not smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Physical state Liquid.

Form Liquid.

Color Brown.

Odor Mild. Cherry.

Odor threshold Not Established

pH Not Applicable

Melting point/freezing point Not Established

Initial boiling point and boiling range 320 - 392 °F (160 - 200 °C)

Flash point 104.5 °F (40.3 °C) Tag Closed Cup

Evaporation rate 0.2 (butyl acetate = 1)

Flammability (solid, gas) Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) 0.6 %

Flammability limit - upper (%) 6 %

Explosive limit - lower (%) Not available.

Explosive limit - upper (%) Not available.

Vapor pressure 2.6 mm Hg @ 20°C

Vapor density 4.8 (air = 1)

Relative density Not available.

Solubility(ies)

Solubility (water) Insoluble

Partition coefficient (n-octanol/water) Not Established

Auto-ignition temperature	446 °F (230 °C) (concentrate)
Decomposition temperature	Not Established
Viscosity	20 - 550 cP
Other information	
Density	6.82
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.
Percent volatile	78.45 %
Specific gravity	0.81 @ 20°C
VOC	75.58 % per U.S. State and Federal Consumer Product Regulations

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Avoid heat, sparks, open flames and other ignition sources. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause drowsiness and dizziness. Headache. Nausea, vomiting. Prolonged inhalation may be harmful.
Skin contact	Causes skin irritation.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia.
Symptoms related to the physical, chemical and toxicological characteristics	Aspiration may cause pulmonary edema and pneumonitis. May cause drowsiness and dizziness. Headache. Nausea, vomiting. Skin irritation. May cause redness and pain.

Information on toxicological effects

Acute toxicity May be fatal if swallowed and enters airways. Narcotic effects.

Components	Species	Test Results
1-butoxy-2-propanol (CAS 5131-66-8)		
Acute		
Dermal		
LD50	Rabbit	1400 mg/kg, 24 Hours
Oral		
LD50	Rat	> 2000 mg/kg
Calcium Carbonate (CAS 471-34-1)		
Acute		
Dermal		
LD50	Rat	> 2000 mg/kg, 24 Hours
Oral		
LD50	Rat	> 2000 mg/kg
Distillates Petroleum Hydrotreated Heavy (CAS 64742-54-7)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg

Components	Species	Test Results
Inhalation		
LC50	Rat	> 3.9 mg/l, 4 Hours
Oral		
LD50	Rat	> 2000 mg/kg

Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)

Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Inhalation		
Vapor		
LC50	Rat	> 4.5 mg/l, 4 Hours

Hydrodesulferized Heavy Petroleum Naptha (CAS 64742-82-1)

Acute		
Dermal		
LD50	Rabbit	> 1900 mg/kg, 24 Hours
Oral		
LD50	Rat	4820 mg/kg

Xylene (CAS 1330-20-7)

Acute		
Oral		
LD50	Rat	3523 mg/kg

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

Respiratory sensitization Not a respiratory sensitizer.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.

ACGIH Carcinogens

Xylene (CAS 1330-20-7) A4 Not classifiable as a human carcinogen.

IARC Monographs. Overall Evaluation of Carcinogenicity

Xylene (CAS 1330-20-7) 3 Not classifiable as to carcinogenicity to humans.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure May cause drowsiness and dizziness.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Prolonged inhalation may be harmful.

Further information None known.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Calcium Carbonate (CAS 471-34-1)			
Aquatic			
Fish	LC50	Western mosquitofish (Gambusia affinis)	> 56000 mg/l, 96 hours
Distillates Petroleum Hydrotreated Light (CAS 64742-47-8)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	2.9 mg/l, 96 hours
Xylene (CAS 1330-20-7)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	7.711 - 9.591 mg/l, 96 hours

Persistence and degradability Not inherently biodegradable.

Bioaccumulative potential

Partition coefficient n-octanol / water (log Kow)

Xylene	3.12 - 3.2

Mobility in soil No data available.

Other adverse effects None known.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number UN1268
UN proper shipping name Petroleum distillates, n.o.s. or Petroleum products, n.o.s. Mixture
Transport hazard class(es)
Class 3
Subsidiary risk -
Label(s) 3
Packing group III
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.
Special provisions 144, B1, IB3, T4, TP1, TP29
Packaging exceptions 150
Packaging non bulk 203
Packaging bulk 242

IATA

UN number UN1268
UN proper shipping name Petroleum products, n.o.s. Mixture
Transport hazard class(es)
Class 3
Subsidiary risk -
Packing group III
Environmental hazards No.
ERG Code 3L
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.
Other information
Passenger and cargo aircraft Allowed with restrictions.

Cargo aircraft only	Allowed with restrictions.

IMDG

UN number	UN1268
UN proper shipping name	PETROLEUM DISTILLATES, N.O.S. or PETROLEUM PRODUCTS, N.O.S. MIXTURE
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	No.
EmS	F-E, S-E
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not established.

DOT

IATA; IMDG

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Xylene (CAS 1330-20-7) Listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - Yes Pressure Hazard - No Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Xylene (CAS 1330-20-7)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

Distillates Petroleum Hydrotreated Heavy (CAS 64742-54-7)
Hydrodesulferized Heavy Petroleum Naptha (CAS 64742-82-1)
Xylene (CAS 1330-20-7)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 06-08-2016

Revision date 07-11-2017

Version # 03

Disclaimer ITW Pro Brands cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Revision information Composition / Information on Ingredients: Disclosure Overrides
Physical & Chemical Properties: Multiple Properties
Regulatory Information: Risk Phrases - Labeling
GHS: Classification

SAFETY DATA SHEET

Version 17.2 replaces Version 17.1
Revision date: 22.08.2018
According to (EU) No. 2015/830

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

1.1 Product identifier: **SPOTCHECK® SKC-S - aerosol**

1.2 Relevant identified uses of the mixture and uses advised against:

Relevant identified uses: Solvent cleaner used in penetrant inspection.

Uses advised against: This product is not recommended for any use other than the identified uses above.

1.3 Details of the supplier of the safety data sheet

Manufacturer: Magnaflux® (A Division of ITW Ltd)

Address: Faraday Road, South Dorcan Industrial Estate, Swindon, UK

Postcode: SN3 5HE

Telephone/fax number:
Telephone: +44 (0)1793 524566
Fax: +44 (0)1793 490459
Web: www.eu.magnaflux.com

Email address of competent person responsible for SDS: support.eu@magnaflux.com

National contact: None appointed.

1.4 Emergency telephone number: DURING OFFICE HOURS, CALL
T: +44 (0)1793 524566 (English only)

Opening hours: Office hours (GMT) Monday - Thursday 8am - 5pm, Friday 8am - 4pm
OUT OF OFFICE HOURS, CALL
T: +44(0)203 394 9866

SECTION 2 HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No 1272/2008 (CLP):

Physical and Chemical Hazard:
Aerosol 1 H222, H229

Health Hazard:
Skin Irrit. 2 H315
STOT SE 3 H336

Environmental Hazard:
Aquatic Chronic 2 H411

Additional information No other information.

For full text of hazard statements and EU hazard statements see SECTION 16.

2.2 Label Elements:

Labelling according to regulation (EC) No 1272/2008 [CLP]

Signal Word:	DANGER
Hazard Statement(s):	H222: Extremely flammable aerosol. H229: Pressurised container: may burst if heated. H315: Causes skin irritation H336: May cause drowsiness or dizziness H411: Toxic to aquatic life with long lasting effects
Precautionary Statement(s):	P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. P211: Do not spray on an open flame or other ignition source. P251 Do not pierce of burn even after use. P410 + P412: Protect from sunlight. Do not expose to temperatures exceeding 50 °C. P261: Avoid breathing dust/fume/gas/mist/vapours/spray. P280: Wear protective gloves/protective clothing/eye protection/face protection. P501: Dispose of contents/container to hazardous waste or special collection point.
Supplementary Precautionary Statement(s):	P271: Use only outdoors or in a well ventilated area. P302+352: IF ON SKIN: Wash with soap and water P264: Wash thoroughly after handling. P362+P364: Take off contaminated clothing and wash it before reuse.
Supplementary Hazard Information (EU)	None
Hazard Determining Component(s)	Hydrocarbons, C7 – C9, isoalkanes

2.3 Other hazards:

Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Vapours can form explosive mixtures with air.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

3.2 Mixtures

Ingredient Name	CAS No	EC No	REACH Registration Number	% Weight	Classification according to Regulation (EC) No 1272/2008 [CLP]	Additional information
Hydrocarbons, C7- C9, isoalkanes		921-728-3	01-2119471305-42	60 -100	Flam. Liq 2: H225 Skin Irrit. 2: H315 STOT SE3: H336 Asp. Tox. 1: H304 (note1) Aquatic Chronic 2: H411	No other information
Hydrocarbons, C3-4-rich petroleum distillate petroleum gas (1.3 butadiene < 0.1%)	68512-91-4	270-990-9	(note2)	10-30	Press. Gas H280 Flam. Gas 1 H220	(note3)

1. Mixtures classified as Asp. Tox. 1 H304 need not be labelled when placed on the market in aerosol containers or in containers fitted with a sealed spray attachment.
2. Exempted from the obligation to register in accordance with art.2(7)(a) of REACH Regulation No 1907/2006
3. Not classified as carcinogen, less than 0.1% w/w 1,3 butadiene (EINECS no 203-450-8)

Note: Hazard statement(s) in this section apply only to raw materials, not necessarily to finished products.
**See Section 16 for hazard statement(s) text in full.*

SECTION 4 FIRST AID MEASURES

4.1 Description of first aid measures:

General notes: If symptoms persist, seek medical attention. Show this safety data sheet to the doctor in attendance.

Following inhalation: Remove to fresh air. Keep at rest. If not breathing give artificial respiration. Seek prompt medical attention if discomfort persists.

Following skin contact: Flush with water, use soap if available. Contaminated clothing should be washed before re-use. Seek medical attention if irritation persists.

Following eye contact: Flush eyes with large amounts of water for at least 15 minutes with eyelids held open. Seek medical attention if irritation persists.

Following ingestion: Unlikely route of exposure. Rinse mouth with water. Do NOT induce vomiting. If vomiting occurs, keep head low so that stomach contents don't enter the lungs. Never give anything by mouth to an unconscious person. Seek medical attention immediately.

Self-protection of the first aider: No action shall be taken involving any personal risk or without suitable training. If it is suspected that the mixture is still present, wear appropriate personal protective equipment.

4.2 Most important symptoms, both acute and delayed:

Prolonged skin contact may cause redness and irritation.
In high concentrations, vapours are anaesthetic and may cause headache, fatigue, dizziness and central nervous system effects.
Fumes from the stomach contents may be inhaled resulting in the same symptoms as inhalation. Avoid vomiting and normal rinse of stomach because of risk of aspiration.
May cause discomfort to the eyes. Symptoms: redness and pain.

4.3 Indication of any immediate medical attention and special treatment needed:

None known.

SECTION 5 FIREFIGHTING MEASURES

5.1 Extinguishing media:

Suitable extinguishing media: Carbon dioxide, foam, dry chemical, water fog or spray.

Unsuitable extinguishing media: Do not use water jet.

5.2 Special hazards arising from the substance or mixture: Evacuate immediate area. Shut off 'fuel' to fire. If possible keep unaffected containers cool with water spray.
Aerosols may explode in a fire.
Aerosol contents are extremely flammable.

Hazardous combustion products: Smoke, soot and oxides of carbon. Burning vapour may give off toxic fumes.

5.3 Advice for fire-fighter:

Warn firefighters that aerosols are involved. Self contained breathing apparatus and full protective clothing must be worn. Water spray should be used to cool containers. Contaminated extinguishing water must be disposed of in accordance with official regulations.

SECTION 6 ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures:

Suitable protective equipment (see Section 8) should be worn to prevent any contamination of skin, eyes and personal clothing.

For non-emergency personnel: Remove ignition sources. Avoid breathing vapours, mist or gas.

For emergency responders: Remove ignition sources. Avoid breathing vapours, mist or gas. Keep unnecessary people at a safe distance.

6.2 Environmental precautions:

Prevent liquid from entering drains, sewers and watercourses. Notify the Environment Agency or water authorities if a major spillage occurs.

6.3 Methods and material for containment and cleaning up:

Eliminate sources of ignition. Take measures to prevent the build-up of electrostatic charge.
Avoid breathing vapours. Ventilate surrounding area.

For containment: Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite).
Place in a UN approved container for disposal.
Large spills should be pumped (using an earthed explosion proof pump) into UN approved containers pending disposal.
Dispose of waste according to local/national regulations.

For cleaning up: Do not flush away residues with water.

Other information: No other information.

6.4 Reference to other sections:

For Personal Protective Equipment see Section 8. For disposal information see Section 13.

SECTION 7 HANDLING & STORAGE

7.1 Precautions for safer handling:

Protective Measures:	Wear suitable protective clothing such as chemical resistant gloves, apron and goggles/face mask to protect from splashes. Ensure adequate exhaust ventilation when in use. Avoid contact with skin and eyes. Do not breathe product spray or mist. Risk of vapour concentration in low areas.
Measures to prevent fire:	Aerosol contents are highly flammable and volatile. Keep away from sources of ignition – no smoking. Take measures to prevent the build-up of electrostatic charge. Equipment should be earthed. Use explosion proof electrical/ventilating/lighting equipment. Use only non-sparking tools.
Advice on general occupational hygiene:	Wash thoroughly after handling.

7.2 Conditions for safe storage, including any incompatibilities:

Technical measures and storage conditions:	Store in a cool dry area away from heat and sources of ignition.
Packaging materials:	Store in original container.
Requirements for storage rooms and vessels:	Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50 ºC. Recommended storage temperature 10 ºC to 30 ºC.
Further information on storage conditions:	Rotate stock and check regularly for damaged items.

7.3 Specific end use(s):

Recommendations:	Use only for Non Destructive Testing (NDT) applications.
Industrial sector specific solutions:	See product data sheet for further information.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters:

Occupational exposure limit values:

Occupational exposure figures have been set for some of the components of this preparation based on GESTIS International Limit Values or manufacturers' recommendation.

Ingredient name	Country	Limit value - 8 hours		Limit value - short term	
		ppm	mg /m^3	ppm	mg /m^3
Hydrocarbons, C7 – C9, isoalkanes	UK	241	1200		
Data obtained from GESTIS International Limit Values, EH40, supplier's SDS					

Note: Where no specific short-term exposure limit is listed, a figure three times the long-term exposure limit should be used.

Derived No Effect Level (DNEL) - Hydrocarbons, C7 – C9, isoalkanes

End User	Exposure Route	Exposure Time	Effects	DNEL
Worker	Inhalation	Long term	Systemic	2035 mg/m^3
Worker	Dermal	Long term	Systemic	773 mg/kg bw/day

Note: The Derived No Effect Level (DNEL) is an estimated safe level of exposure that is derived from toxicity data in accordance with specific guidance within the European REACH regulation. The DNEL may differ from an Occupational Exposure Limit (OEL) for the same chemical. OELs may be recommended by an individual company, a government regulatory body or an expert organization, such as the Scientific Committee for Occupational Exposure Limits (SCOEL) or the American Conference of Governmental Industrial Hygenists (ACGIH). OELs are considered to be safe exposure levels for a typical worker in an occupational setting for an 8-hour work shift, 40 hour work week, as a time weighted average (TWA) or a 15 minute short-term exposure limit (STEL). While also considered to be protective of health, OELs are derived by a process different from that of REACH.

Predicted No Effect Concentration (PNEC) - Hydrocarbons, C7 – C9, isoalkanes

Water - Fresh Water	No data available: testing technically not feasible
Water - Marine Water	No data available: testing technically not feasible
Water - Intermittent release	No data available: testing technically not feasible
Sediment - Fresh water	No data available: testing technically not feasible
Sediment - Marine water	No data available: testing technically not feasible
Soil	No data available: testing technically not feasible
Sewage Treatment plant	No data available: testing technically not feasible

8.2 Exposure controls:

Concentrations of product vapours and mists in the working atmosphere must be kept as low as is reasonably practicable. Exposure should be minimised by the use of appropriate containment, engineering control and ventilation measures. Where this is not possible, personal protective equipment should be worn as indicated below where appropriate.

Appropriate engineering controls: Provide adequate ventilation, including appropriate local extraction, to ensure that the defined occupational exposure limits are not exceeded

Personal protection equipment:

Eye and face protection: Safety glasses with side-shields conforming to EN166.

Skin protection - hand: Protective gloves conforming to EN374-3. Use chemical resistant gloves recommended by glove manufacturer as being suitable for **isoparaffins**, if hand exposure is unavoidable.
Protective gloves made of **nitrile rubber** are suitable, although other types may be more suitable in other circumstances.
For prolonged exposure, recommended gloves with protective index 6, > 480 minutes permeation time according to EN374.
Consult the glove manufacturer for exact breakthrough time. Glove manufacturer's directions for use should be observed.

Skin protection – other: Wear impervious, flame retardant antistatic protective clothing. The type of protective equipment must be selected according to the concentration and amount of dangerous substance at the specific workplace.

Respiratory protection:	In case of insufficient ventilation, wear suitable respiratory equipment. Filter type A. (EN 136, 140, 405, 149, 143) For higher level protection use type ABEK-P3 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under CEN standards.
Thermal hazards:	Not applicable.
Environmental exposure controls:	Avoid any release to the environment.

SECTION 9 PHYSICAL & CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties:

Appearance:	Aerosol containing mobile clear liquid.
Odour:	Mild hydrocarbon.
Odour threshold:	No data available.
pH:	Neutral.
Melting point/freezing point:	No data available.
Initial boiling point and boiling range:	113 – 143 °C.
Flash point (PMCC):	-40 °C (aerosol propellant).
Evaporation rate (BuAc = 100):	155.
Flammability (solid, gas) (Limits in air):	No data available.
Upper/lower flammability or explosive limits:	0.7 – 6.0% (Vol%)
Vapour pressure:	1.627 kPa @ 20 °C.
Vapour density (Air = 1):	> 1.
Relative density:	0.72 g/cm^3.
Solubility:	Insoluble.
Partition coefficient: n-octanol/water:	No data available.
Auto-ignition temperature:	> 200 °C.
Decomposition temperature:	No data available.
Viscosity (ASTM D445):	0.86 mm^2/s @ 25 °C.
Explosive properties:	Under normal conditions no danger of explosion.
Oxidising properties:	No data available.

Note: properties relate to the bulk product only unless otherwise stated.

9.2 Other information:
No other information.

SECTION 10 STABILITY & REACTIVITY

10.1	**Reactivity:**	No specific reactivity hazards associated with this product.
10.2	**Chemical stability**	Stable under normal conditions of use and applications.
10.3	**Possibility of hazardous reactions:**	No data available.
10.4	**Conditions to avoid:**	Keep away from sources of ignition, hot surfaces and direct sun light.
10.5	**Incompatible materials:**	Strong oxidising agents.
10.6	**Hazardous decomposition materials:**	None under normal conditions of use. Smoke, soot and oxides of carbon on combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects: based on data for component materials.

Acute toxicity - oral: Based on the available data, the classification criteria are not met.

Acute toxicity – dermal: Based on the available data, the classification criteria are not met.

Acute toxicity – inhalation: Based on the available data, the classification criteria are not met.

Skin corrosion/irritation: Skin Irrit. 2 H315: Causes skin irritation.

Serious eye damage/irritation: Based on the available data, the classification criteria are not met.

Respiratory sensitisation: Data lacking.

Skin sensitisation: Based on the available data, the classification criteria are not met.

Germ cell mutagenicity: Based on the available data, the classification criteria are not met.

Carcinogencity: Data lacking.

Reproductive toxicity: Based on the available data, the classification criteria are not met.

STOT single exposure: STOT Single Exp. 3 H336: May cause drowsiness or dizziness.
Affected organs: central nervous system
Route of exposure: inhalation

STOT repeated exposure: Based on the available data, the classification criteria are not met.

Aspiration hazard: Mixtures from Aerosol Dispensors - need not be classified as Asp. Tox. 1 - H304 as the aerosol spray is fine and a pool of product may not be formed in the mouth.

Information on likely Routes of Exposure and Potential Health Effects:

Inhalation: Vapour concentrations above the recommended exposure levels are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anaesthetic and may have other central nervous system effects.

Ingestion: Not a likely route of exposure. However, harmful: May cause lung damage if swallowed. Ingestion may cause irritation of the mouth, throat and digestive tract. Small amounts of product aspirated into the respiratory system during ingestion or from vomiting may cause bronchopneumonia or pulmonary edema.

Eye contact: May cause redness and pain.

Skin contact: Frequent or prolonged contact with the product may produce irritation and/or skin dryness and cracking. Product will have a de-fatting effect on the skin.

Toxicity Test Results: based on data for component materials, where available.

Hydrocarbons, C7 – C9, isoalkanes

Acute Toxicity – oral	LD50 (rat)	> 5000 mg/kg
Acute Toxicity – dermal	LD50 (rabbit)	> 2000 mg/kg
Acute Toxicity – inhalation	LC50 (rat)	21 mg/l (4 h; vapour)

Other Information: No other information.

SECTION 12 ECOLOGICAL INFORMATION

Based on data for component materials

12.1 Toxicity:

Hydrocarbons, C7 – C9, isoalkanes

Fish	Oncorhynchus mykiss	LL50	96h	18.4 mg/l
Aquatic Invertebrates	Daphnia magna	EL50	48h	2.4 mg/l
Aquatic Plants	Pseudokirchneriella subcapitata	EL50	72h	29 mg/l

12.2 Persistence and degradability: Hydrocarbons, C7 – C9, isoalkanes - Biodegradable.

12.3 Bioaccumulative potential: No data available.

Partition coefficient: n-octanol/water (log Kow): No data available.

Bioconcentration factor (BCF): No data available.

12.4 Mobility in soil: The product is immiscible with water and will spread on the water surface. Product is highly volatile - will partition rapidly to air.

12.5 Results of PBT and vPvB assessment: This mixture does not contain any substances that are assessed to be a PBT or vPvB.

12.6 Other adverse effects: No data available.

SECTION 13 DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods:

Dispose of waste and residues in accordance with local authority requirements. Seek the advice of an approved waste disposal contractor for disposal at a licensed facility in accordance with national legislation.

Product/packing disposal: Empty containers may contain residual product and flammable vapours. Do not pierce or burn container, even after use. Do NOT remove labels. Keep away from sources of ignition.

Waste codes/waste designations according to LoW: 16 05 04* gases in pressure containers containing dangerous substances.

NOTE: Waste codes are assigned based upon the most common uses for this material and may not reflect contaminants resulting from actual use. Waste producers need to assess the actual process used when generating the waste and its contaminants in order to assign the proper waste code(s).

Waste treatment – relevant information: Dispose of waste and residues in accordance with local authority requirements. Seek the advice of an approved waste disposal contractor for disposal at a licensed facility in accordance with national legislation

Sewage disposal – relevant information: Do not empty down the drain.

Other disposal recommendations: Use a licensed waste contractor

SECTION 14 TRANSPORT INFORMATION

14.1	**UN number:**	ADR/RID:	UN1950
		IMDG:	UN1950
		IATA:	UN1950
14.2	**UN proper shipping name:**	ADR/RID:	AEROSOLS, flammable
		IMDG:	AEROSOLS, flammable
		IATA:	AEROSOLS, flammable
14.3	**Transport hazard class(es):**	ADR/RID:	2.1
		IMDG:	2.1
		IATA:	2.1
14.4	**Packing group:**	ADR/RID:	N/A
		IMDG:	N/A
		IATA:	N/A
14.5	**Environmental hazards:**	ADR/RID:	Yes
		IMDG:	Marine Pollutant: Yes
		IATA:	Yes

14.6 Special precautions for user:

ADR/RID – Tunnel code:	(D)
IMDG – Ems:	F-D, S-U
IATA/ICAO – PAX:	203
IATA/ICAO – CAO:	203

14.7 Transport in bulk according to Annex II of Marpol 73/78 and the IBC code:
Not applicable

SECTION 15 REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

EU Regulations:
This data sheet complies with the requirements of Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures.
Safety data sheet as required by EC-Regulations 1907/2006 and REACH Annex II Amendment (EU) No. 2015/830.

Information according to 2013/10/EU and 2008/47/EC amendment of the aerosol directive 75/324/EEC.
This data sheet is complied according Dir 2013/10/EU, 2008/47/EEC amendment of the aerosol directive 75/324/EEC.

Extra label elements: Pressured container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material**.**
Mixtures classified as Asp. Tox. 1 H304 need not be labelled when placed on the market in aerosol containers or in containers fitted with a sealed spray attachment.

National regulations (Germany):

Wassergefahrdungklasse (water hazard class):	WGK 2 - Hazard to waters.
TechnischeAnleitungLuft (TA-Luft):	Class 5.2.5 Organic Substances, except dusts

15.2 Chemical safety assessment:
No data available

SECTION 16 OTHER INFORMATION

(i) Indication of changes:
Version 17.2 updated in Section 1.3.

Vertical lines on the left hand side indicate an amendment from the previous version.

(ii) Abbreviations and acronyms:

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road (Accord européen relatif au transport international des marchandises Dangereuses par Route)
CAS No.	Chemical Abstracts Service number
CEN	European Committee for Standardisation
CLP	Classification, Labelling Packaging Regulation; Regulation (EC) No 1272/2008
ECHA	European Chemicals Agency
EC50	Half Maximal Effective Concentration
EC number	EINECS and ELINCS number
EINECS	European Inventory of Existing Commercial Substances
ELINCS	European List of notified Chemical Substances
GHS	Globally Harmonized System
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
LC50	Lethal Concentration to 50% of a test population
LD50	Lethal Dose to 50% of a test population
MPI	Magnetic Particle Inspection
NDT	Non-Destructive Testing
OEL	Occupational Exposure Limit
PBT	Persistent, Bioaccumulative and Toxic Substance
PMCC	Pensky-Martens closed cup method
PPE	Personal Protection Equipment
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation EC (No) 1907/2006
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail (Reglement International concernant le transport des marchandises Dangereuses par chemin de fer)
SDS	Safety Data Sheet
STOT RE	Specific Target Organ Toxicity, Repeat Exposure
STOT SE	Specific Target Organ Toxicity, Single Exposure
TA-Luft	Technical Instructions on Air Quality Control (Technische Anleitung zur Reinhaltung der Luft)
vPvB	Very Persistent and Very Bioaccumulative
WEL	Workplace Exposure Limit
WGK	German Water Hazard Class (Wassergefährdungsklasse)

(iii) Key literature and sources of data:

- Supplier's safety data sheets for components listed in Section 3.
- European Chemicals Agency, http://echa.europa.eu/
- GESTIS International Limit Values Database, http://limitvalue.ifa.dguv.de/Webform_gw.aspx
- Occupational Exposure Limits EH40/2005.
- Commission regulation (EU) 2015/830.
- Control of Substances Hazardous to Health Regulations 2002.
- Hazardous waste regulations 2005.
- Health & Safety at Work Act 1974.
- Regulation (EC) No. 1907/2006 (REACH).
- Regulation (EC) No. 1272/2008 (CLP).

(iv) Classification and procedure used to derive the classification for mixtures according to Regulation (EC) 1272/2008 (CLP):

Classification according to Regulation (EC) No 1272/2008	Classification procedure
Aerosol. 1: H222, H229	Test Method
Skin Irrit. 2: H315	Calculation Method
STOT SE3: H336:	Calculation Method
Aquatic Chronic 2: H411	Calculation Method

(v) Hazard statements (number and full text):

H220: Extremely flammable gas.
H225: Highly flammable liquid and vapour
H222: Extremely flammable aerosol.
H229: Pressurised container: may explode if heated.
H280: Contains gas under pressure; may burst if heated.
H304: May be fatal if swallowed and enters airways
H315: Causes skin irritation
H336: May cause drowsiness or dizziness
H411: Toxic to aquatic life with long lasting effects

Hazard Class and Category Code (full text):

Aerosol 1: Aerosol
Aquatic Chronic 2: Hazardous to the aquatic environment
Asp. Tox. 1: Aspiration hazard
Flam. Gas 1: Flammable Gas
Flam. Liq. 2: Flammable liquid
Press. Gas: Gases under pressure
Skin Irrit. 2: Skin corrosion/irritation
STOT SE 3: Specific target organ toxicity - single exposure

Relevant precautionary statements (number and full text):

P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P211: Do not spray on an open flame or other ignition source.
P251 Do not pierce of burn even after use.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P271: Use only outdoors or in a well ventilated area.
P410 + P412: Protect from sunlight. Do not expose to temperatures exceeding 50 °C.
P280: Wear protective gloves/protective clothing/eye protection/face protection
P302+352: IF ON SKIN: Wash with soap and water
P362+P364: Take off contaminated clothing and wash it before reuse.
P264: Wash thoroughly after handling.
P501: Dispose of contents/container to hazardous waste or special collection point.

(vi) Training advice:

Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene. Chemical hazard risk assessment. Provide adequate information, instruction and training to operators.

SAFETY DATA SHEET

DISCLAIMER

The information and recommendations contained herein are based upon data believed to be up-to-date and correct. However, no guarantee or warranty of any kind, express or implied, is made with respect to the information and recommendations contained herein. We accept no responsibility and disclaim all liability for any harmful effects that may be caused by (incorrect) use, handling, purchase, resale, or exposure to our product. Customers and users of our product must comply with all applicable health and safety laws, regulations, and orders. In particular, they are under an obligation to carry out a risk assessment for the particular work places and to take adequate risk management measures in accordance with the national implementation legislation of EU Directives 89/391/EEC and 98/24/EC amended by Directive 2014/27/EU.

Revision summary:	**Revision Comments**	This SDS is valid from the Revision Date. If you require a SDS for the product manufactured before the Revision Date please contact us at support.eu@magnaflux.com.
	Revision Date	22.08.2018
	Version	17.2

SAFETY DATA SHEET

Version 17.2 replaces Version 17.1
Revision date: 22.08.2018
According to (EU) No. 2015/830

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

1.1 Product identifier: **SPOTCHECK® SKD-S2 - aerosol**

1.2 Relevant identified uses of the mixture and uses advised against:

Relevant identified uses: Solvent developer used in penetrant inspection.

Uses advised against: This product is not recommended for any use other than the identified uses above.

1.3 Details of the supplier of the safety data sheet

Manufacturer: Magnaflux® (A Division of ITW Ltd)

Address: Faraday Road, South Dorcan Industrial Estate, Swindon, UK

Postcode: SN3 5HE

Telephone/fax number:
Telephone: +44 (0)1793 524566
Fax: +44 (0)1793 490459
Web: www.eu.magnaflux.com

Email address of competent person responsible for SDS: support.eu@magnaflux.com

National contact: None appointed.

1.4 Emergency telephone number: DURING OFFICE HOURS, CALL
T: +44 (0)1793 524566 (English only)

Opening hours: Office hours (GMT) Monday - Thursday 8am - 5pm, Friday 8am - 4pm
OUT OF OFFICE HOURS, CALL
T: +44(0)203 394 9866

SECTION 2 HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No 1272/2008 (CLP):

Physical and Chemical Hazard:
Aerosol 1 H222, H229

Health Hazard:
Eye Irrit. 2 H319
STOT SE 3 H336

Environmental Hazard:
None

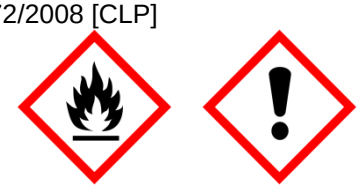
Additional information EUH066

For full text of hazard statements and EU hazard statements see SECTION 16.

2.2 Label Elements:

Labelling according to regulation (EC) No 1272/2008 [CLP]

Hazard Pictograms:



Signal Word:	Danger
Hazard Statement(s):	H222: Extremely flammable aerosol H229: Pressurised container. May burst if heated. H319: Causes serious eye irritation H336: May cause drowsiness or dizziness
Precautionary Statement(s):	P210: Keep away from heat, sparks, open flames and hot surfaces. No smoking. P211: Do not spray on an open flame or other ignition source. P251: Do not pierce or burn, even after use. P261: Avoid breathing dust/fume/gas/mist/vapours/spray. P410+P412: Protect from sunlight. Do not expose to temperatures exceeding 50 °C. P280: Wear protective gloves/ protective clothing/ eye protection/ face protection.
Supplementary Precautionary Statement(s):	P243: Take precautionary measures against static discharge. P264: Wash thoroughly after handling. P271: Use only outdoors or in a well-ventilated area. P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. P303+P361+P353: IF ON SKIN: Take off immediately all contaminated clothing. Rinse skin with water. P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing. P337+P313: If eye irritation persists get medical advice/attention. P501: Dispose of contents/container to hazardous waste or special collection point.
Supplementary Hazard Information (EU)	EUH066
Hazard Determining Component(s)	Acetone Propan-2-ol

2.3 Other hazards:

Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50 °C.

Vapours can form explosive mixtures in air.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

3.2 Mixtures

Ingredient Name	CAS No	EC No	REACH Registration Number	% Weight	Classification according to Regulation (EC) No 1272/2008 [CLP]	Additional information
Propan-2-ol	67-63-0	200-661-7	01-2119457558-25	< 40	Flam. Liq 2 H225 Eye Irrit. 2 H319 STOT SE3 H336	None
Acetone	67-64-1	200-662-2	01-2119471330-49	< 15	Flam. Liq 2 H225 Eye Irrit. 2 H319 STOT SE3 H336	EUH066
Hydrocarbons, C3-4-rich petroleum distillate petroleum gas (1.3 butadiene < 0.1%)	68512-91-4	270-990-9	(1)	< 50	Press. Gas H280 Flam. Gas 1 H220	(2)
Talc	14807-96-6	238-877-9	Exempted in accordance with Annex V.7	< 2	Not classified	Has WEL
Aluminium Hydroxide	21645-51-2	244-492-7	01-2119529246-39	< 2	Not classified	Has WEL
Calcium Carbonate	471-34-1	207-439-9	01-2119486795-18	< 2	Not classified	Has WEL

1. Exempted from the obligation to register in accordance with art.2(7)(a) of REACH Regulation No 1907/2006
2. Not classified as carcinogen, less than 0.1% w/w 1,3 butadiene (EINECS no 203-450-8)

Note: Hazard statement(s) in this section apply only to raw materials, not necessarily to finished products.
**See Section 16 for hazard statement(s) text in full.*

SECTION 4 FIRST AID MEASURES

4.1 Description of first aid measures:

General notes: If symptoms persist, seek medical attention. Show this safety data sheet to the doctor in attendance.

Following inhalation: Remove to fresh air. Keep at rest. If not breathing give artificial respiration. Seek medical attention if symptoms occur.

Following skin contact: Flush with water, use soap if available. Take off contaminated clothing and wash before re-use. Seek medical attention if irritation persists.

Following eye contact: Flush eyes with large amounts of water for at least 10 minutes. Check for and remove any contact lenses if easy to do. Continue rinsing. Seek medical attention if irritation persists.

Following ingestion: Unlikely route of exposure. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth thoroughly. Seek medical attention if symptoms occur.

Self-protection of the first aider: No action shall be taken involving any personal risk or without suitable training. If it is suspected that the mixture is still present, wear appropriate personal protective equipment.

4.2 Most important symptoms, both acute and delayed:

Irritation to eyes. No delayed effects known.

4.3 Indication of any immediate medical attention and special treatment needed:
None known.

SECTION 5 FIREFIGHTING MEASURES

5.1 Extinguishing media:

Suitable extinguishing media: Carbon dioxide, foam, dry chemical, water fog or spray.

Unsuitable extinguishing media: Do not use water jet.

5.2 Special hazards arising from the substance or mixture: Evacuate immediate area. Shut off 'fuel' to fire. If possible, keep unaffected containers cool with water spray. Aerosols may explode in a fire. Aerosol contents are extremely flammable.

Hazardous combustion products: Smoke, soot and oxides of carbon. Burning vapour may give off toxic fumes.

5.3 Advice for fire-fighter:
Warn firefighters that aerosols are involved.
Cool containers exposed to flames with water until well after the fire is out.
Self contained breathing apparatus and full protective clothing must be worn.
Fire water run-off must not be allowed to contaminate ground, or enter drains, sewers or water courses.

SECTION 6 ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures:
Suitable protective equipment (see Section 8) should be worn to prevent any contamination of skin, eyes and personal clothing.

For non-emergency personnel: Remove ignition source. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.

For emergency responders: Keep unnecessary people at a safe distance. Remove ignition source. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.

6.2 Environmental precautions:
Prevent liquid from entering drains, sewers and watercourses. Notify the Environment Agency or water authorities if a major spillage occurs. Prevent product from contaminating soil.

6.3 Methods and material for containment and cleaning up:
Ventilate well. Eliminate sources of ignition. Take measures to prevent the build-up of electrostatic charge.

For containment: Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite). Place in a UN approved container for disposal.
Large spills should be pumped (using an earthed explosion proof pump) into UN approved containers pending disposal. Dispose of waste according to local/national regulations.

For cleaning up: Rinse site with copious amounts of water, which should not be allowed into drains, sewers or watercourses.

Other information: No other information.

6.4 Reference to other sections:
For Personal Protective Equipment see Section 8. For disposal information see Section 13.

SECTION 7 HANDLING & STORAGE

7.1 Precautions for safer handling:

Protective Measures: Wear suitable protective clothing such as chemical resistant gloves, apron and goggles/face mask to protect from splashes. Avoid contact with skin and eyes. Do not breathe product spray or mist. Ensure adequate exhaust ventilation when in use.

Measures to prevent fire: Aerosol contents are highly flammable and volatile. Keep away from sources of ignition - no smoking. Take measures to prevent the build-up of electrostatic charge. Equipment should be earthed. Use explosion proof electrical/ventilating/lighting equipment. Use only non-sparking tools.

Advice on general occupational hygiene: Wash thoroughly after handling.

7.2 Conditions for safe storage, including any incompatibilities:

Technical measures and storage conditions: Store in a cool dry area away from heat and sources of ignition. Keep containers tightly closed when not in use.

Packaging materials: Store in original container.

Requirements for storage rooms and vessels: Pressurised container: protect from sunlight and do not expose to temperatures exceeding 50 ºC.
Recommended storage temperature 10 ºC to 30 ºC.

Further information on storage conditions: Rotate stock and check regularly for damaged items.

7.3 Specific end use(s):

Recommendations: Use only for Non Destructive Testing (NDT) applications.

Industrial sector specific solutions: See product data sheet for further information.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters:

Occupational exposure limit values:

Occupational exposure figures have been set for some of the components of this preparation based on GESTIS International Limit Values or manufacturers' recommendation.

Ingredient name	Country	Limit value - 8 hours		Limit value - short term	
		ppm	mg /m^3	ppm	mg /m^3
Propan-2-ol	UK	400	999	500	1250
	Germany (AGS)	200	500	400 (1)	1000 (1)
	Sweden	150	350	250 (1)	600 (1)
Acetone	UK	500	1210	1500	3620
	Germany (AGS)	500	1200	1000 (1)	2400(1)
	Sweden	250	600	500(1)	1200(1)
	EU	500	1210		
Talc (respirable dust)	UK		1		
	Germany		2		
	Sweden		1		

Aluminium Hydroxide (respirable dust)	Germany (DFG)		1.5		
Calcium Carbonate (respirable aerosol)	UK		4		
Calcium Carbonate (inhalable dust)	UK		10		
(1) 15 minutes average value					
Data obtained from GESTIS International Limit Values, EH40, supplier's SDS					

Note: Where no specific short-term exposure limit is listed, a figure three times the long-term exposure limit should be used.

Derived No Effect Level (DNEL) – Acetone

End User	Exposure Route	Exposure Time	Effects	DNEL
Worker	Inhalation	Long term	Systemic	1210 mg/m^3
Worker	Inhalation	Short term	Local	2420 mg/m^3
Worker	Dermal	Long term	Systemic	186 mg/kg bw/day

Derived No Effect Level (DNEL) –Propan-2-ol

End User	Exposure Route	Exposure Time	Effects	DNEL
Worker	Inhalation	Long term	Systemic	500 mg/m^3
Worker	Dermal	Long term	Systemic	888 mg/kg/day

Derived No Effect Level (DNEL) – Aluminium Hydroxide

End User	Exposure Route	Exposure Time	Effects	DNEL
Worker	Inhalation	Long term	Systemic	10.76 mg/m^3
Worker	Inhalation	Short term	Local	10.76 mg/m^3

Derived No Effect Level (DNEL) – Calcium Carbonate

End User	Exposure Route	Exposure Time	Effects	DNEL
Worker	Inhalation	Long term	Systemic	10 mg/m^3
Worker	Inhalation	Long term	Local	4.26 mg/m^3

Note: The Derived No Effect Level (DNEL) is an estimated safe level of exposure that is derived from toxicity data in accordance with specific guidance within the European REACH regulation. The DNEL may differ from an Occupational Exposure Limit (OEL) for the same chemical. OELs may be recommended by an individual company, a government regulatory body or an expert organization, such as the Scientific Committee for Occupational Exposure Limits (SCOEL) or the American Conference of Governmental Industrial Hygenists (ACGIH). OELs are considered to be safe exposure levels for a typical worker in an occupational setting for an 8-hour work shift, 40 hour work week, as a time weighted average (TWA) or a 15 minute short-term exposure limit (STEL). While also considered to be protective of health, OELs are derived by a process different from that of REACH.

Predicted No Effect Concentration (PNEC)

	Acetone	Propan-2-ol	Aluminium Hydroxide	Calcium Carbonate
Water - Fresh Water	10.6 mg/l	140.9 mg/l	No hazard identified	No data
Water - Marine Water	1.06 mg/l	140.9 mg/l	No hazard identified	No data
Water - Intermittent release	21 mg/l	140.9 mg/l	No hazard identified	No data
Sediment - Fresh water	30.4 mg/kg dw	552 mg/kg	No data	No data
Sediment - Marine water	3.04 mg/kg dw	552 mg/kg	No data	No data
Soil	33.3 mg/kg dw	28 mg/kg	No data	No data
Sewage Treatment plant	100 mg/l	2251 mg/kg	No hazard identified	100 mg/l

8.2 Exposure controls:

Concentrations of product vapours and mists in the working atmosphere must be kept as low as is reasonably practicable. Exposure should be minimised by the use of appropriate containment, engineering control and ventilation measures. Where this is not possible, personal protective equipment should be worn as indicated below where appropriate.

Appropriate engineering controls:	Provide adequate ventilation, including appropriate local extraction, to ensure that the defined occupational exposure limits are not exceeded. Provide eye wash station. If ventilation is insufficient suitable respiratory protection must be provided.
Personal protection equipment:	
Eye and face protection:	Safety glasses with side-shields conforming to EN166.
Skin protection - hand:	Protective gloves conforming to EN374-3. Use chemical resistant gloves recommended by glove manufacturer as being suitable for isopropyl alcohol, if hand exposure is unavoidable. Protective gloves made of Butyl or Nitrile are suitable although other types may be more suitable in other circumstances. For prolonged exposure, recommended gloves with protective index 6, >480 minutes permeation time according to EN374. As the product is a preparation, consult the glove manufacturer for exact breakthrough time. Glove manufacturer's directions for use should be observed.
Skin protection – other:	Wear impervious, flame retardant antistatic protective clothing. The type of protective equipment must be selected according to the concentration and amount of dangerous substance at the specific workplace.
Respiratory protection:	Use a respirator with approriate canister type filter cartridge if spraying in confined or unventilated areas. Respirator Type AX (EN371). For higher level protection use type ABEK-P3 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under CEN standards.
Thermal hazards:	Not applicable.
Environmental exposure controls:	Avoid any release to the environment.

SECTION 9 PHYSICAL & CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties:

Appearance:	Aerosol containing mobile white liquid
Odour:	Solvent – alcoholic
Odour threshold:	No data available
pH:	Neutral
Melting point/freezing point:	No data available
Initial boiling point and boiling range:	75 °C
Flash point (PMCC):	-40 °C (aerosol propellant)
Evaporation rate (BuAC = 100):	250
Flammability (solid, gas) (Limits in air):	No data available
Upper/lower flammability or explosive limits:	2 – 15% (Vol %)
Vapour pressure:	138 mm Hg @ 38 °C
Vapour density (Air = 1):	> 1
Relative density:	0.88 g/cm^3
Solubility:	87%
Partition coefficient: n-octanol/water:	+ 0.05 (Propan-2-ol)
Auto-ignition temperature:	No data available
Decomposition temperature:	No data available
Viscosity (ASTM D445):	< 10 mm^2/s @ 20 °C
Explosive properties:	No data available
Oxidising properties:	No data available

Note: properties relate to the bulk product only unless otherwise stated.

9.2 Other information:
No other information

SECTION 10 STABILITY & REACTIVITY

10.1	**Reactivity:**	No data available.
10.2	**Chemical stability**	Stable under normal conditions of use and applications.
10.3	**Possibility of hazardous reactions:**	No data available.
10.4	**Conditions to avoid:**	Keep away from sources of ignition, hot surfaces and direct sunlight.
10.5	**Incompatible materials:**	Strong oxidizing agents. Acids and alkalis.
10.6	**Hazardous decomposition materials:**	None under normal conditions of storage and use. Smoke, soot and oxides of carbon on combustion.

SECTION 11 TOXICOLOGICAL INFORMATION

11.1 **Information on toxicological effects:** based on data for component materials.

Acute toxicity - oral:	Based on the available data, the classification criteria are not met.
Acute toxicity – dermal:	Based on the available data, the classification criteria are not met.
Acute toxicity – inhalation:	Based on the available data, the classification criteria are not met.
Skin corrosion/irritation:	EUH066: Repeated exposure may cause skin dryness and cracking
Serious eye damage/irritation:	Eye Irrit. 2 H319: Causes serious eye irritation
Respiratory sensitisation:	Based on the available data, the classification criteria are not met.
Skin sensitisation:	Based on the available data, the classification criteria are not met.
Germ cell mutagenicity:	Based on the available data, the classification criteria are not met.
Carcinogencity:	Based on the available data, the classification criteria are not met.
Reproductive toxicity:	Based on the available data, the classification criteria are not met.
STOT single exposure:	STOT SE3 H336: May cause drowsiness or dizziness. Route of exposure: Inhalation and oral
STOT repeated exposure:	Based on the available data, the classification criteria are not met.
Aspiration hazard:	Based on the available data, the classification criteria are not met.

Information on likely Routes of Exposure and Potential Health Effects:

Inhalation:	Vapour concentrations above the recommended exposure levels are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anaesthetic and may have other central nervous system effects.
Ingestion:	Not a likely route of exposure. Ingestion may cause irritation of the mouth, throat and digestive tract. Absorption of large amounts may cause systemic effects.
Eye contact:	This mixture is classified as an eye irritant.
Skin contact:	Frequent or prolonged contact with the product may produce irritation and/or skin dryness and cracking. Product will have a de-fatting effect on the skin.

Toxicity Test Results: based on data for component materials, where available.

Acetone

Acute Toxicity – oral	LD50 (rat)	5800 mg/kg
Acute Toxicity – dermal	LD50 (rabbit)	> 7400 mg/kg
Acute Toxicity – inhalation	LC50 (rat)	76000 mg/l (vapours) 4 hr

Propan-2-ol

Acute Toxicity – oral	LD50 (rat)	4700 – 5800 mg/kg
Acute Toxicity – dermal	LD50 (rabbit)	13000 mg/kg
Acute Toxicity – inhalation	LC50 (rat)	19000 ppm/8hr

Aluminium Hydroxide

Acute Toxicity – oral	LD50 (rat)	> 2000 mg/kg
Acute Toxicity – inhalation	LC50 (rat)	> 2.3 mg/L (4h)

Calcium Carbonate

Acute Toxicity – oral	LD50 (rat)	> 5000 mg.kg

Other Information: No other information

SECTION 12 ECOLOGICAL INFORMATION

Based on data for component materials

12.1 Toxicity:

Acetone

Fish	Onchorhynchus mykiss	LC50	96 hours	5540 mg/l
Aquatic Invertebrates	Daphnia pulex	EC50	48 hours	8800 mg/l
Aquatic Invertebrates	Daphnia magna	EC10	28 days	2212 mg/l
Microorganisms	Activated sludge	EC10	30 mins.	1000 mg/l

Propan-2-ol

Fish	LC50	96h	9640 – 10400 mg/l
Daphnia	EC50	48h	7550 – 13299 mg/l
Algae	IC50	72h	> 1000 mg/l

Calcium Carbonate

Fish	LC50	96h	> 200 mg/l
Daphnia	EC50	46h	> 1000 mg/l
Algae	IC50	72h	> 10000 mg/l

12.2 Persistence and degradability: Propan-2-ol: readily biodegradable
Acetone: readily biodegradable

12.3 Bioaccumulative potential: This preparation does not contain any substances expected to be bioaccumulative.

Partition coefficient: n-octanol/water (log Kow): +0.05 (propan-2-ol)
-0.24 @ 20 °C (acetone)

Bioconcentration factor (BCF): 3 (acetone)

12.4 Mobility in soil: This product will evaporate into the atmosphere from the surfaces of water and soil.

12.5 Results of PBT and vPvB assessment: This mixture does not contain any substances that are assessed to be a PBT or vPvB.

12.6 Other adverse effects: No data available.

SECTION 13 DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods:
Dispose of waste and residues in accordance with local authority requirements. Seek the advice of an approved waste disposal contractor for disposal at a licensed facility in accordance with national legislation.

Product/packing disposal:	Empty containers may contain residual product and flammable vapours. Do not pierce or burn container, even after use. Do NOT remove labels. Keep away from sources of ignition.
Waste codes/waste designations according to LoW:	16 05 04* gases in pressure containers containing dangerous substances.

NOTE: Waste codes are assigned based upon the most common uses for this material and may not reflect contaminants resulting from actual use. Waste producers need to assess the actual process used when generating the waste and its contaminants in order to assign the proper waste code(s).

Waste treatment – relevant information:	Dispose of waste and residues in accordance with local authority requirements. Seek the advice of an approved waste disposal contractor for disposal at a licensed facility in accordance with national legislation
Sewage disposal – relevant information:	Do not empty down the drain.
Other disposal recommendations:	Use a licensed waste contractor.

SECTION 14 TRANSPORT INFORMATION

14.1	**UN number:**	ADR/RID:	UN1950
		IMDG:	UN1950
		IATA:	UN1950
14.2	**UN proper shipping name:**	ADR/RID:	AEROSOLS, flammable
		IMDG:	AEROSOLS, flammable
		IATA:	AEROSOLS, flammable
14.3	**Transport hazard class(es):**	ADR/RID:	2.1
		IMDG:	2.1
		IATA:	2.1
14.4	**Packing group:**	ADR/RID:	N/A
		IMDG:	N/A
		IATA:	N/A
14.5	**Environmental hazards:**	ADR/RID:	No
		IMDG:	Marine Pollutant: No
		IATA:	No

14.6 Special precautions for user:

ADR/RID – Tunnel code:	(D)
IMDG – Ems:	F-D, S-U
IATA/ICAO – PAX:	203
IATA/ICAO – CAO:	203

14.7 Transport in bulk according to Annex II of Marpol 73/78 and the IBC code:
Not applicable

SECTION 15 REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

EU Regulations:

This data sheet complies with the requirements of Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures.

Safety data sheet as required by EU Regulations 1907/2006 and REACH Annex II Amendment (EU) No. 2015/830.

Information according to 2013/10/EU and 2008/47/EC amendment of the aerosol directive 75/324/EEC.

This data sheet is complied according Dir 2013/10/EU, 2008/47/EEC amendment of the aerosol directive 75/324/EEC.

Extra label elements: Pressured container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material**.**

National regulations (Germany):

Wassergefahrdungklasse (water hazard class):	WGK1 - Low hazard to waters
TechnischeAnleitungLuft (TA-Luft):	Class 5.2.5 Organic Substances, except dusts

15.2 Chemical safety assessment:

No chemical safety assessment has been carried out for this mixture by the supplier.

SECTION 16 OTHER INFORMATION

(i) Indication of changes:

Version 17.2 updated in Section 1.3.

Vertical lines on the left hand side indicate an amendment from the previous version.

(ii) Abbreviations and acronyms:

ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road (Accord européen relatif au transport international des marchandises Dangereuses par Route)
CAS No.	Chemical Abstracts Service number
CEN	European Committee for Standardisation
CLP	Classification, Labelling Packaging Regulation; Regulation (EC) No 1272/2008
ECHA	European Chemicals Agency
EC50	Half Maximal Effective Concentration
EC number	EINECS and ELINCS number
EINECS	European Inventory of Existing Commercial Substances
ELINCS	European List of notified Chemical Substances
GHS	Globally Harmonized System
IATA	International Air Transport Association
IMDG	International Maritime Dangerous Goods
LC50	Lethal Concentration to 50% of a test population
LD50	Lethal Dose to 50% of a test population
MPI	Magnetic Particle Inspection
NDT	Non-Destructive Testing
OEL	Occupational Exposure Limit
PBT	Persistent, Bioaccumulative and Toxic Substance
PMCC	Pensky-Martens closed cup method
PPE	Personal Protection Equipment
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation EC (No) 1907/2006
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail

	(Reglement International concernant le transport des marchandises Dangereuses par chemin de fer)
SDS	Safety Data Sheet
STOT RE	Specific Target Organ Toxicity, Repeat Exposure
STOT SE	Specific Target Organ Toxicity, Single Exposure
TA-Luft	Technical Instructions on Air Quality Control (Technische Anleitung zur Reinhaltung der Luft)
vPvB	Very Persistent and Very Bioaccumulative
WEL	Workplace Exposure Limit
WGK	German Water Hazard Class (Wassergefährdungsklasse)

(iii) Key literature and sources of data:

- Supplier's safety data sheets for components listed in Section 3.
- European Chemicals Agency, http://echa.europa.eu/
- GESTIS International Limit Values Database, http://limitvalue.ifa.dguv.de/Webform_gw.aspx
- Occupational Exposure Limits EH40/2005.
- Commission regulation (EU) 2015/830.
- Control of Substances Hazardous to Health Regulations 2002.
- Hazardous waste regulations 2005.
- Health & Safety at Work Act 1974.
- Regulation (EC) No. 1907/2006 (REACH).
- Regulation (EC) No. 1272/2008 (CLP).

(iv) Classification and procedure used to derive the classification for mixtures according to Regulation (EC) 1272/2008 (CLP):

Classification according to Regulation (EC) No 1272/2008	Classification procedure
Aerosol 1 H225, H229	Test method
Eye Irrit. 2 H319	Calculation method
STOT SE3 H336	Calculation method
EUH066	Calculation method

(v) Hazard statements (number and full text):

H220: Extremely flammable gas
H222: Extremely flammable aerosol
H225: Highly flammable liquid and vapour
H229: Pressurised container. May burst if heated.
H280: Contains gas under pressure; may explode if heated.
H319: Causes serious eye irritation
H336: May cause drowsiness or dizziness
EUH066: Repeated exposure may cause skin dryness or cracking

Hazard Class Category Code (full text):

Aerosol 1: Aerosol
Eye Irrit. 2: Serious eye damage/eye irritation
Flam. Gas 1: Flammable gas
Flam. Liq. 2: Flammable liquid
Press. Gas: Gases under pressure
STOT SE3: Specific target organ toxicity - single exposure

Relevant precautionary statements (number and full text):

P210: Keep away from heat, sparks, open flames and hot surfaces. No smoking.
P211: Do not spray on an open flame or other ignition source.
P251: Do not pierce or burn, even after use.
P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
P271: Use only outdoors or in a well-ventilated area.
P410+P412: Protect from sunlight. Do not expose to temperatures exceeding 50 °C
P243: Take precautionary measures against static discharge.
P264: Wash thoroughly after handling
P280: Wear protective gloves and eye protection.
P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P303+P361+P353: IF ON SKIN: Take off immediately all contaminated clothing. Rinse skin with water.

P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P337+P313: If eye irritation persists get medical advice/attention
P501: Dispose of contents/container to hazardous waste or special collection point.

(vi) Training advice:

Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene. Chemical hazard risk assessment. Provide adequate information, instruction and training to operators.

DISCLAIMER

The information and recommendations contained herein are based upon data believed to be up-to-date and correct. However, no guarantee or warranty of any kind, express or implied, is made with respect to the information and recommendations contained herein. We accept no responsibility and disclaim all liability for any harmful effects that may be caused by (incorrect) use, handling, purchase, resale, or exposure to our product. Customers and users of our product must comply with all applicable health and safety laws, regulations, and orders. In particular, they are under an obligation to carry out a risk assessment for the particular work places and to take adequate risk management measures in accordance with the national implementation legislation of EU Directives 89/391/EEC and 98/24/EC amended by Directive 2014/27/EU.

Revision summary:	**Revision Comments**	This SDS is valid from the Revision Date. If you require a SDS for the product manufactured before the revision date please contact us at support.eu@magnaflux.com.
	Revision Date	22.08.2018
	Version	17.2

STIHL MOTOMIX®

Packaged for Stihl Incorporated, 536 Viking Drive, Virginia Beach, VA 23452

Safety Data Sheet

Conforms to HCS 2012 (29 CFR 1910.1200)

Section 1. Identification

Product identifier

Product Name: **STIHL MOTOMIX® High Performance Patented Fuel**

Part/Product Number(s): 7010-871-0203, 7010-871-0204, 7010-871-0234, 7010-871-0235, 7010-871-0248 7010-871-0249, 7010-319-0003, 7010-319-0004, 7010-871-0273

Material Use: Premixed 2-cycle engine fuel mixture

Uses advised against: Not for use in non-2-cycle engines

Manufacturer: Omni Specialty Packaging, LLC
10399 Hwy 1 South
Shreveport, LA 71115
1-318-524-1100

Issuing date: June 3, 2015

Revision date: November 29, 2016

Revision number: 005

Company contact: OMNI EHS Department: E-Mail: sds@osp.cc; Contact phone: 318-524-1100 (Monday-Friday, 8:00 AM – 4:00 PM, CST)

In case of emergency: CHEMTREC: Within USA and Canada: 1 (800) 424-9300 (24/7)
CHEMTREC: Outside USA and Canada: +1 703-527-3887 (24/7)

Section 2. Hazards Identification

OSHA/HCS Status: This product is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

US GHS Classification of the Substance or Mixture:

Flammable Liquid – Category 1
Aspiration Hazard – Category 1
Skin Corrosion/Irritation – Category 2
Specific Target Organ Toxicity (Single Exposure) – Category 3 (respirator irritation, narcosis)
Hazardous to the Aquatic Environment – Chronic – Category 2

GHS Label Elements

Hazard pictograms:

Signal word: DANGER

Hazard statement: Extremely flammable liquid and vapor.
Causes skin irritation.
May cause drowsiness or dizziness.
May be fatal if swallowed and enters airways.
Toxic to aquatic life with long lasting effects.

Precautionary statements

General: Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Prevention:
Keep away from heat/sparks/open flames/hot surfaces. No smoking.
Keep container tightly closed.
Ground and bond container and receiving equipment.
Use explosion-proof electrical/ventilating/lighting/equipment. Use only non-sparking tools.
Take precautionary measures against static discharge.
Use personal protective equipment as required.
Wear protective gloves/protective clothing/eye protection/face protection.
Wash hands and forearms thoroughly after handling.
Do not breathe mist/vapors/ sprays.
Use only outdoors or in well-ventilated area.
Do not eat, drink or smoke when using this product.
Avoid release to the environment.

Response:
Collect spillage.
In case of fire: Use water spray, fog, dry chemical fire extinguishers or hand held fire extinguisher.
IF ON SKIN (or hair): Wash with plenty of soap and water.
Remove/Take off immediately all contaminated clothing and wash before reuse. If skin irritation occurs, get medical advice/attention.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a poison center or doctor/physician if you feel unwell.
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. Do not induce vomiting.

Storage:
Store in a well-ventilated place.
Keep cool. Keep container tightly closed.
Store locked up.

Disposal: Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazards not otherwise classified (HNOC): Defatting to the skin.

Section 3. Composition/Information on Ingredients

Mixture consisting of the following components, special 2-stroke gasoline.

Substance/Mixture: Mixture

Components Name	CAS number	Weight %*	GHS Classification
Naphtha (petroleum), full-range alkylated, butane-contg.	68527-27-5	50 – 100	Flam. Liq. 1, Asp. Tox. 1, Skin Irrit. STOT-SE 3, Aquatic Acute 2, Aquatic Chronic 2
Methylbutane (Isopentane)	78-78-4	10 – 25	Flam. Liq. 1, Asp. Tox. 1, STOT-SE 3, Aquatic Chronic 2
Hydrocarbons, C4, 1,3-Butadiene-free, polymd., triisobuylene fraction, hydrogenated	93685-81-5	10 – 25	Flam. Liq. 1, Asp. Tox. 1, Aquatic Chronic 4
2-Cycle Engine Oil Additives Mixture	Proprietary	<1	Not classified

* The exact percentage of composition has been withheld as a trade secret.

Section 4. First Aid Measures

Description of necessary first aid measures

Eye contact: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Check for and remove any contact lenses. Get medical attention.

Skin contact: Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention if irritation or redness develops.

Inhalation: If inhaled, remove to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Get medical attention immediately.

Ingestion: Do NOT induce vomiting. Do not give liquids. Obtain immediate medial attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration (inhalation into respiratory system). Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

Protection of first-aiders: No action shall be taken involving any personal risk or without suitable training. Remove all sources of ignition. Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed

See Section 11 for more detailed information on health effects and symptoms.

Most Important

Symptoms and Effects: Aspiration hazard. If material enters lungs, signs and symptoms may include coughing, choking, wheezing, and/or fever. The onset of respiratory symptoms may be delayed for several hours after exposure. Breathing of high vapor concentrations may cause central nervous system (CNS) depression resulting in dizziness, light-headedness, headache, nausea and loss of coordination. Continued inhalation may result in unconsciousness and death. Eye irritation signs and symptoms may include burning sensation and a temporary redness of the eye. Skin irritation signs and symptoms may include burning sensations, redness, swelling, and /or blisters.

Note to physician: Treat symptomatically.

Section 5. Fire-Fighting Measures

Uniform Fire Code: Class IB

Flash Point: <-56°C (-68.8°F)

Extinguishing Media

Suitable Media: In case of fire, use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Use water fog, fire fighting foam (suitable for polar solvents), dry chemical, carbon dioxide (CO2) extinguisher or spray.

Unsuitable Media: CAUTION: Use of water spray when fighting fire may be inefficient.

Specific Hazards Arising from the Chemical: Keep product and empty container away from heat and sources of ignition as product will burn. Contact with strong oxidizers may cause fire. Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignitions. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Will float on water and can be reignited on the surface of water. In the event of fire, cool tanks with water spray. Fire residues and contaminated fire extinguishing water must be contained, prevented from being discharged to any waterway, sewer or drain and disposed of in accordance with local regulations.

Hazardous Combustion Products: Combustion products may include the following: Carbon dioxide (CO2) Carbon monoxide (CO), Nitrogen oxides and non-combusted hydrocarbons (smoke).

Protection of Fire Fighters: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

Section 6. Accidental Release Measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from

entering. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Do not touch or walk through spilled material. Put on appropriate personal protective equipment. Floors may be slippery; use care to avoid falling.

For emergency responders: Response and clean-up crews must be properly trained and must use proper protective equipment (see Section 8). Evacuate nonessential personnel and remove or secure all sources of ignition. Consider wind direction; stay upwind and uphill, if possible. Evacuate the direction of product travel, diking sewers, etc. to contain spill area. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact. If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. Pay attention to flashback. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. See also the information in "For non-emergency personnel".

Environmental precautions: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers by diking, absorbents, or absorbent booms, if possible. The use of fire fighting foam may be useful in certain situations to reduce vapors. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). See Section 12 for ecological information.

Methods and materials for containment and cleaning up

Small Spills: Stop leak if without risk. Move containers from spill area. Absorb with an inert material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large Spills: Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Contain and collect spillage with non- combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Dispose of via a licensed waste disposal contractor.

NOTE: If RQ (Reportable Quantity) is exceeded or if spills enter a body of water, report immediately to the USEPA's National Response Center at (800) 424-8802. Check with your local and state regulators regarding their reporting requirements

Section 7. Handling and Storage

Precautions for safe handling

Protective measures: USE ONLY AS A MOTOR FUEL. DO NOT SIPHON BY MOUTH. Handle as a flammable liquid. Keep away form head, sparks, and open flame! Bond and ground product transfer to reduce the possibility of static-initiation of fire or explosion. Eye protection and face shield should be used if material is used under conditions that increase the chances of splattering. Put on appropriate personal protective equipment (see Section 8). Keep out of reach of children.

Advice on general occupational hygiene: Do not get in eyes, on skin or on clothing. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash thoroughly after handling. Remove contaminated clothing and protective equipment before entering eating areas.
See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, Including any incompatibilities: Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials, strong oxidizing agents (see Section 10) and food and drink. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). Keep container tightly closed and sealed until ready for use. Carry out filling operations only out door or in an area with good ventilation/exhaustion at the workplace. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Use appropriate containment to avoid environmental contamination. Avoid contaminating soil or releases into sewage or drainage systems and bodies of water.

Bulk material handling: Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient.

Section 8. Exposure Controls/Personal Protection

Control parameters

Occupational Exposure Limits

Chemical name	ACGIH		OSHA		NIOSH	
	TLV TWA	STEL	PEL	STEL	TWA	STEL
Naphtha (petroleum), full-range alkylated, butane-contg.	200 ppm	No data	No data	No data	No data	No data
Methylbutane (Isopentane)	600 ppm	No data	No data	No data	No data	No data
Hydrocarbons, C4, 1,3-Butadiene-free, polymd., triisobuylene fraction, hydrogenated	No data	No data	No data	No data	No data	No data

Appropriate engineering controls: Use adequate ventilation to keep vapor concentration of this product below occupational exposure and flammable limits, particularly in confined spaces.

Environmental exposure controls: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures: Keep away form foodstuffs, beverages and food. Wash hands, forearms and face thoroughly after handling product before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Avoid contact with the eyes and skin. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/Face Protection: Wear safety glasses with side shields. A face shield or chemical goggles where there is a possibility of splashing or spraying

Skin and Body Protection

Hand protection: Wear protective gloves if prolonged or repeated contact is likely. Wear chemical resistant gloves. Recommended: Nitrile. Always seek advice from your glove suppliers. Consult your supervisor or Standard Operating Procedure (SOP) for special handling instructions.

Body protection: None required for normal product use. For non-routine or spill response, chemical protective closing such as E.I DuPont TyChem® , Saranex® or equivalent recommend based on degree of exposure. For non-routine tasks, personal protection equipment for the body should be selected based on the task being performed and the risks involved.

Other skin protection: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved.

Respiratory protection: No respiratory protection is normally required if used outdoors or in a well ventilated area. A NIOSH/MSHA approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may exceed exposure limits of odor or irritation. Protection provided by air –purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstances where an air-purifying respirator may not provide adequate protection.

Section 9. Physical and Chemical Properties

Appearance **(Typical or Target)**

Physical State: Liquid

Color: Light green

Odor:	Petroleum distillates
Odor threshold:	Not available
pH:	Not applicable
Boiling Point:	35 to 180°C (95 to 356°F)
Flash Point (Closed cup):	< -56°C (< -68.8°F) (Typical or Target)
Pour Point:	Not determined
Evaporation rate (Butyl acetate = 1):	Not available
Flammability (solid, gas):	Not applicable. Based on - Physical state
Flammable) Limit in Air	
Lower Flammability Limit (LEL):	1.1%
Upper Flammability Limit (FEL):	6.0%
Vapor pressure at 50 °C:	< 95 kPa
Vapor density (Air = 1):	>1
Relative density at 20 °C:	0.7 g/cm3 (Typical or Target)
Solubility:	Not miscible or difficult to mix
Partition coefficient (n-Octanol/water):	Not available
Auto-ignition temperature:	Not available
Decomposition temperature:	Not available
Viscosity – Kinematic (cSt (mm2/s)@ 40°C):	Not determined
Viscosity – Dynamic (cSt (mm2/s) @ 100°C):	Not determined
VOCContent:	98.0 g/l / 0.82 lb/gal

Section 10. Stability and Reactivity

Reactivity:	Not reactive under normal storage conditions
Chemical stability:	Stable under normal storage conditions
Possibility of hazardous reactions:	None under normal processing.
Hazardous polymerization:	Hazardous polymerization does not occur.
Conditions to avoid:	Heat, flames and sparks.
Incompatible materials:	Oxidizing agents, Halogens, Halogenated compounds
Hazardous decomposition products:	May include: Fumes, Oil vapors, Smoke, Carbon Oxides (including carbon monoxide and carbon dioxide), Aldehydes, Nitrogen oxides, and incomplete combustion products.

Section 11. Toxicological Information

Information on toxicological effects

Basis for Assessment: Information given is based on product data, a knowledge of the components and the toxicity of similar products.

Likely Routes of Exposure: Exposure may occur via inhalation, ingestion, skin absorption

Substance/Mixture

Acute Toxicity	Oral LD50	Dermal LD50	Inhalation LC50
Naphtha (petroleum), full-range alkylated, butane-contg. (68527-27-5)	>5000 mg/kg (rat)	>2000 mg/kg (rabbit)	>5 mg// (rat)
Methylbutane (78-78-4)	>2000 mg/Kg (rat) (OECD 401)	No data	>25.3 mg/L (rat) 4h (OECD 403)

Aspiration hazard:	Aspiration hazard – Category 1.
Skin Corrosion/Irritation:	Irritating to skin and mucus membranes.
Serious Eye Damage/Irritation:	No irritating effect.
Respiratory Irritation:	No further relevant information available.
Skin Sensitization:	No sensitizing effect known.
Respiratory Sensitization:	No further relevant information available.
Specific Target Organ Toxicity (Single Exposure) - STOT-SE:	Category 3 High concentrations may cause central nervous system (CNS) depression resulting in headaches, dizziness and nausea: continued inhalation may result in

unconsciousness and/or death. (Naphtha (petroleum), full-range aklylate, butane-contg. Metylbutane,

Specific Target Organ Toxicity (Repeated Exposure) – STOT-RE: No further relevant information available.

Carcinogenicity: No further relevant information available.

Germ Cell Mutagenicity: No further relevant information available.

Reproductive Toxicity: No further relevant information available.

Section 12. Ecological Information

The information is based on data available for the material, the components of the material, and similar materials.

Ecotoxicity: Toxic to fish.

Mobility: No further relevant information available.

Soil/water partition coefficient (K_{OC}): No further relevant information available..

Persistence and degradation
Biodegradation: Not available.

Bioaccumulative potential
Bioaccumulation: No further relevant information available.

Other adverse effects: No further relevant information available.

Other ecological information: Water hazard class 2 (manufacturer Self-assessment): hazardous to water. Do not allow product to reach ground water, water bodies or sewage systems. Danger to drinking water if even small quantities leak into soil. Also, poisonous for fish and plankton in water bodies. Toxic for aquatic organisms.

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Section 13. Disposal Considerations

Disposal recommendations based on material supplied.

Waste treatment methods: This material may be a hazardous waste according to Federal regulations (40 CFR 261). Consult the appropriate state, regional, or local regulations for additional requirements. The generation of waste should be avoided or minimized wherever possible.

Product waste: Significant quantities of waste product residues should not be disposed of via the sanitary sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements.

Contaminated packaging: Empty containers or liners may retain some product residues and could pose a potential fire and explosion hazard. Do not cut, puncture, or weld containers.

Other information: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport Information

General information: Gasoline mixture.

	DOT Classification	IMDG	IATA
UN Number	UN 1203	UN 1203	UN 1203
Proper Shipping Name	Gasoline	Gasoline	Gasoline
Hazard class(s)	3	3	3
Packaging group	II	II	II

Environmental hazards	No	Yes	No
Marine Pollutant	Yes	Yes	-
Addition information	**Limited Quantity :** Yes **Packaging instructions:** **Passenger aircraft** Quantity Limitation: 5 L **Cargo Aircraft:** Quantity Limitation: 60 L **Special provisions** 144, 177, B1, B33, IB2, T8 **Remarks:** May be classed as a Consumer Commodity, ORM-D for Small Packages, see 49CFR173.150	The marine pollutant mark is not required when transported in sized of ≤ 5L or ≤ 5 kg. **Emergency schedules (EmS):** F-E, S-E Limited Quantity (LQ) : 1 L Excepted Quantity (EQ) Code E2 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 500 ml **Special provisions:** 243	The environmentally hazardous substance mark may appear if required by other transportation regulations. **Passenger and Cargo Aircraft:** Quantity Limitation: 5 L Packaging instructions: 353 **Cargo Aircraft Only:** Quantity Limitation: 60 L Packaging instructions: 364 **Limit Quantity – Passenger Aircraft:** Quantity Limitation: 1L Packaging instructions: Y341 **Special provisions:** A100

Special precautions for user: Transport within user's premises: Always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Section 15. Regulatory Information

United States Regulations

United States Inventory (TSCA 8b): All components are listed or exempted.

SARA 302/304: No products were found.

SARA 311/312:

Immediate (Acute) Health Effects:	Yes
Delayed (Chronic) Health Effects:	Yes
Fire Hazard:	Yes
Sudden Release of Pressure Hazard:	No
Reactivity Hazard:	No

SARA 313:

The following components of this material are found on the EPCRA 313 list:
None

Supplier notification: This product does not contain any hazardous ingredients at or above regulated thresholds.

CWA (Clean Water Act): This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA: This material, as supplied, does not contain any substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302).

State Regulations

Massachusetts: The following components are listed: None
New Jersey: The following components are listed: Methy lbutane
New York: The following components are listed: None
Pennsylvania: The following components are listed: None
California Proposition 65: WARNING: This product does not contain any chemical known to the State of California to cause cancer or to cause birth defects.

Section 16. Other Information

NFPA Rating:	**Health Hazard – 1**	**Flammability – 3**	**Instability/Reactivity – 0**
HMIS Rating:	**Health Hazard – 1**	**Flammability – 3**	**Physical Hazards – 0**

(NFPA & HMIS Hazard Rating Key: 0 - Minimum Hazard; 1 - Slight Hazard; 2 - Moderate Hazard; 3 - High Hazard; 4 - Extreme Hazard; * - Chronic Hazard Indicator, & PPE - Personal Protective Equipment Index A to L. These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS or Hazardous Material Identification System).

Key to abbreviations:

OSHA = Occupational Safety and Health Administration
ACGIH= American Conference of Industrial Hygienists
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
CAS = Chemical Abstracts Service Registry Number
cSt = Centistroke (mm2/s)
GHS = Global Harmonized System of Classification and Labeling Of Chemicals.
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
OEL = Occupational Exposure Limit
SDS = Safety Data Sheet
STEL = Short term exposure Limit
STOT-SE=Specific Target Organ Toxicity-Single Exposure
STOT-RE=Specific Target Organ Toxicity-Repeated Exposure
UN = United Nations
UN Number = United Nations Number, a four digit number assigned by the United Nations Committee of Experts on the Transportation of Dangerous Goods

Prepared By: **OMNI Specialty Packaging EH&S Department**

Revision Date: **November 29, 2016**

Status: **Final**

Revision Note: **Revision 002 – Addition of new 32 oz Part Number**

Consumer Product Improvement Act of 2008, General Conformity Certification

For Consumer Product Packages: This product has been evaluated and is certified to be labeled and packaged in compliance with the applicable provisions of the Federal Hazardous Substance Act as stated in 16 CFR 1500 and enforced by the Consumer Product Safety Commission. Where applicable the products that require Child Resistant Closures are packaged in accordance with the Poison Prevention Packaging Act as stated in 16 CFR 1700 and enforced by the Consumer Product Safety Commission. All closures have been tested in accordance with the latest protocols. No testing is required to certify compliance with the provisions. The date of the manufacturing is stamped on the product container.

Disclaimer

All reasonably practicable steps have been taken to ensure the information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. This information is furnished upon condition that the person receiving it shall make their own determination of the suitability of the material for their particular purpose.

End of Safety Data Sheet

Nickel Chromium Alloy

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Nickel Chromium Alloy - pieces, shot, pellets, rod, wire, target

Other: Nichrome, Nickel-Cr, Chromium-Ni

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Not classified as hazardous

GHS Label Elements:

Signal Word: N/A

Hazard Statements: N/A

Precautionary Statements: N/A

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient:	CAS#:	%:	EC#:
Nickel	7440-02-0	20-80	231-111-4
Chromium	7440-47-3	20-80	231-157-5

4 FIRST AID MEASURES

General Measures: Under normal handling and use, exposure to solid forms of this material present few health

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OFFLINE

Contact

ESPI Metals
1050 Benson Way
Ashland, Oregon 97520

541.488.8311 telephone
800.638.2581 toll-free

541.488.8313 fax
800.488.0060 toll-free fax

sales@espimetals.com

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hazards. Subsequent operations such as grinding, melting or welding may produce potentially hazardous dust or fumes which can be inhaled or come in contact with the skin or eyes.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek medical attention.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, brush material off skin, wash affected area with soap and water. Seek medical attention if symptoms persist.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention if symptoms persist.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other relevant information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use suitable extinguishing media for surrounding material and type of fire.

Unsuitable Extinguishing Media: No information available.

Specific Hazards Arising from the Material: This product does not present fire or explosion hazards as shipped. Small chips, fine turnings and dust from processing may be ignitable. May emit metal oxide fumes under fire conditions.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Avoid dust formation. Avoid contact with skin and eyes. Avoid breathing dust or fume.

Methods and Materials for Containment and Cleaning Up: Sweep or scoop up. Place in a closed container for further handling and disposal. Scrap can be collected for recycling.

Environmental Precautions: Do not allow to enter drains or to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Avoid creating dust. Provide adequate ventilation if dusts are created. See section 8 for information on personal protection equipment.

Conditions for Safe Storage: Store in a sealed container. Store in a cool, dry area. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits:	**OSHA/PEL**:	**ACGIH/TLV**:
Nickel	1 mg/m^3	1.5 mg/m^3
Chromium	1 mg/m^3	0.5 mg/m^3

Engineering Controls: Ensure adequate ventilation to maintain exposures below occupational limits. Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air.

Precious Metal Prices

Nov 04,2019 at 14:55 New York

	Price	Change	High
Gold	1507.70	-6.40	1515.50
Silver	18.01	-0.07	18.30
Platinum	933.00	-15.00	958.00
Palladium	1761.00	-31.00	1832.00

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Respiratory Protection: If permissible levels are exceeded, use NIOSH approved dust respirator.

Eye Protection: Safety glasses

Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Solid in various forms

Color: Silver-gray metallic

Odor: Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: 1400 ^{O}C (Ni80/Cr20)

Boiling Point: No data

Flash Point: N/A

Evaporation Rate: N/A

Flammability: No data

Upper Flammable Limit: No data

Lower Flammable Limit: No data

Vapor Pressure: No data

Vapor Density: N/A

Relative Density (Specific Gravity): 8.4 g/cc (Ni80/Cr20)

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: No data

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: No data

Conditions to Avoid: Avoid creating or accumulating fines or dusts.

Incompatible Materials: No data

Hazardous Decomposition Products: Metal oxide fume.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin, eyes. Product as shipped does not present an inhalation hazard; however subsequent operations may create dusts or fumes which could be inhaled.

Symptoms of Exposure: Fines/dusts may irritate skin and eyes.

Acute and Chronic Effects:

Nickel: The most common harmful health effect of metallic nickel in humans is an allergic skin reaction in those who are sensitive to nickel. Although nickel compounds are known human carcinogens, the evidence suggests that the relatively insoluble metallic nickel is less likely to present a carcinogenic hazard than are the nickel compounds

that tend to release proportionately more nickel ion.

Chromium: Although much is known about the health effects of chromium compounds, the health effects of chromium metal, Cr(0), is not well studied. Due to insolubility most elements in their metallic state are not considered to be serious health hazards.

Acute Toxicity: No data

Carcinogenicity: **Nickel**: **NTP**: R - reasonably anticipated to be a human carcinogen **IARC**: 2B - possibly carcinogenic to humans

Carcinogenicity: **Chromium**: **NTP**: Not identified as carcinogenic **IARC**: 3 - Not classifiable as to carcinogenicity in humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

Shipping Regulations: Not regulated

UN Number: N/A

UN Proper Shipping Name: N/A

Transport Hazard Class: N/A

Packing Group: N/A

Marine Pollutant: No

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): N/A

Canada WHMIS Classification (CPR, SOR/88-66): N/A

HMIS Ratings: **Health**: 0 **Flammability**: 0 **Reactivity**: 0

NFPA Ratings: **Health**: 0 **Flammability**: 0 **Reactivity**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER INFORMATION

The information contained in this document is based on the state of our knowledge at the time of publication and is believed to be correct, but does not purport to be all inclusive and shall be used only as a guide. ESPI Metals

makes no representation, warranty, or guarantee of any kind with respect to the information contained in this document or any use of the product based on this information. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product. Users should satisfy themselves that they have all current data relevant to their particular use.

Prepared by: ESPI Metals

Revised/Reviewed: December 2014

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Nickel

SAFETY DATA SHEET

1 PRODUCT AND SUPPLIER IDENTIFICATION

Product Name: Nickel - pellets, pieces, shot, sheet, foil, rod, wire, target

Formula: Ni

Supplier: ESPI Metals
1050 Benson Way
Ashland, OR 97520

Telephone: 800-638-2581

Fax: 541-488-8313

Email: sales@espimetals.com

Emergency: Infotrac 800-535-5053 (US) or 352-323-3500 (24 hour)

Recommended Uses: Scientific Research

2 HAZARDS IDENTIFICATION

GHS Classification (29 CFR 1910.1200): Not classified as hazardous

GHS Label Elements:

Signal Word: N/A

Hazard Statements: N/A

Precautionary Statements: N/A

3 COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient: Nickel

CAS#: 7440-02-0

%: >99

EC#: 231-111-4

4 FIRST AID MEASURES

Need Help?

Available Mon-Fri 8am to 5pm Pacific Time

LIVE HELP CHAT NOW
OFFLINE

Contact

ESPI Metals
1050 Benson Way
Ashland, Oregon 97520

541.488.8311 telephone
800.638.2581 toll-free

541.488.8313 fax
800.488.0060 toll-free fax

sales@espimetals.com

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General Measures: No special requirements.

INHALATION: Remove to fresh air, keep warm and quiet, give oxygen if breathing is difficult. Seek medical attention.

INGESTION: Rinse mouth with water. Do not induce vomiting. Seek medical attention. Never induce vomiting or give anything by mouth to an unconscious person.

SKIN: Remove contaminated clothing, brush material off skin, wash affected area with soap and water. Seek medical attention if symptoms develop or persist.

EYES: Flush eyes with lukewarm water, including under upper and lower eyelids, for at least 15 minutes. Seek medical attention if symptoms develop or persist.

Most Important Symptoms/Effects, Acute and Delayed: May cause irritation. See section 11 for more information.

Indication of Immediate Medical Attention and Special Treatment: No other relevant information available.

5 FIREFIGHTING MEASURES

Extinguishing Media: Use extinguishing agent suitable for surrounding material and type of fire.

Unsuitable Extinguishing Media: No information available.

Specific Hazards Arising from the Material: May emit toxic metal oxide fumes under fire conditions.

Special Protective Equipment and Precautions for Firefighters: Full face, self-contained breathing apparatus and full protective clothing when necessary.

6 ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures: Wear appropriate respiratory and protective equipment specified in section 8. Isolate spill area and provide ventilation. Avoid breathing dust or fume. Avoid contact with skin and eyes.

Methods and Materials for Containment and Cleaning Up: Avoid dust formation. Sweep or scoop up. Place in properly labeled closed containers.

Environmental Precautions: Do not allow to be released to the environment.

7 HANDLING AND STORAGE

Precautions for Safe Handling: Avoid creating dust. Avoid breathing dust or fumes. Provide adequate ventilation if dusts are created. Avoid contact with skin and eyes. Wash thoroughly before eating or smoking. See section 8 for information on personal protection equipment.

Conditions for Safe Storage: Store in a cool, dry area. Store away from acids. See section 10 for more information on incompatible materials.

8 EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: Nickel

OSHA/PEL: 1 mg/m^3

ACGIH/TLV: 1.5 mg/m^3

Engineering Controls: Ensure adequate ventilation to maintain exposures below occupational limits. Whenever possible the use of local exhaust ventilation or other engineering controls is the preferred method of controlling exposure to airborne dust and fume to meet established occupational exposure limits. Use good housekeeping and sanitation practices. Do not use tobacco or food in work area. Wash thoroughly before eating or smoking. Do not blow dust off clothing or skin with compressed air.

Respiratory Protection: If permissible levels are exceeded, use NIOSH approved dust respirator.

Eye Protection: Safety glasses

Precious Metal Prices

Nov 04,2019 at 14:53 New York		Price	Change	High
Gold	▼	1507.70	-6.40	1515.50
Silver	▼	18.01	-0.07	18.30
Platinum	▼	933.00	-15.00	958.00
Palladium	▼	1760.00	-32.00	1832.00

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Skin Protection: Wear impermeable gloves, protective work clothing as necessary.

9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:

Form: Solid in various forms

Color: Silver gray metallic

Odor: Odorless

Odor Threshold: Not determined

pH: N/A

Melting Point: 1455 ^{O}C

Boiling Point: 2730 ^{O}C

Flash Point: N/A

Evaporation Rate: N/A

Flammability: N/A

Upper Flammable Limit: N/A

Lower Flammable Limit: N/A

Vapor Pressure: 1 mm Hg @ 1810 ^{O}C

Vapor Density: N/A

Relative Density (Specific Gravity): 8.9 g/cc

Solubility in H_2O: Insoluble

Partition Coefficient (n-octanol/water): Not determined

Autoignition Temperature: N/A

Decomposition Temperature: No data

Viscosity: N/A

10 STABILITY AND REACTIVITY

Reactivity: No data

Chemical Stability: Stable under recommended storage conditions.

Possibility of Hazardous Reactions: No data.

Conditions to Avoid: Avoid creating or accumulating fines or dusts.

Incompatible Materials: Acids.

Hazardous Decomposition Products: Nickel oxide fume.

11 TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Inhalation, skin, eyes.

Symptoms of Exposure: May cause irritation. May cause an allergic reaction in sensitized individuals.

Acute and Chronic Effects: The most common harmful health effect of metallic nickel in humans is an allergic skin reaction in those who are sensitive to nickel. Although nickel compounds are known human carcinogens, the evidence suggests that the relatively insoluble metallic nickel is less likely to present a carcinogenic hazard than are the nickel compounds that tend to release proportionately more nickel ion.

Acute Toxicity: No data

Carcinogenicity: **NTP**: R - reasonably anticipated to be a human carcinogen **IARC**: 2B - possibly carcinogenic to humans

To the best of our knowledge the chemical, physical and toxicological characteristics of the substance are not fully known.

12 ECOLOGICAL INFORMATION

Ecotoxicity: No data

Persistence and Degradability: No data

Bioaccumulative Potential: No data

Mobility in Soil: No data

Other Adverse Effects: Do not allow material to be released to the environment without proper governmental permits. No further relevant information available.

13 DISPOSAL CONSIDERATIONS

Waste Disposal Method:

Product: Dispose of in accordance with Federal, State and Local regulations.

Packaging: Dispose of in accordance with Federal, State and Local regulations.

14 TRANSPORT INFORMATION

Shipping Regulations: Not regulated

UN Number: N/A

UN Proper Shipping Name: N/A

Transport Hazard Class: N/A

Packing Group: N/A

Marine Pollutant: No

15 REGULATORY INFORMATION

TSCA Listed: All components are listed.

Regulation (EC) No 1272/2008 (CLP): N/A

Canada WHMIS Classification (CPR, SOR/88-66): N/A

HMIS Ratings: **Health**: 1 **Flammability**: 0 **Physical**: 0

NFPA Ratings: **Health**: 1 **Flammability**: 0 **Instability**: 0

Chemical Safety Assessment: A chemical safety assessment has not been carried out.

16 OTHER INFORMATION

The information contained in this document is based on the state of our knowledge at the time of publication and is believed to be correct, but does not purport to be all inclusive and shall be used only as a guide. ESPI Metals makes no representation, warranty, or guarantee of any kind with respect to the information contained in this document or any use of the product based on this information. ESPI Metals shall not be held liable for any damages resulting from handling or from contact with the above product. Users should satisfy themselves that they have all current data relevant to their particular use.

Prepared by: ESPI Metals

Revised/Reviewed: July 2015

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SAFETY DATA SHEET

Propylene

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Propylene

Chemical name : propylene

Other means of identification : propylene; 1-Propene; propylene in gaseous state, impure; propylene liquefied, impure; propene, pure; propylene, pure

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : propylene; 1-Propene; propylene in gaseous state, impure; propylene liquefied, impure; propene, pure; propylene, pure

SDS # : 001046

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : propylene

Other means of identification : propylene; 1-Propene; propylene in gaseous state, impure; propylene liquefied, impure; propene, pure; propylene, pure

Product code : 001046

CAS number/other identifiers

CAS number : 115-07-1

Ingredient name	%	CAS number
propylene	100	115-07-1

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
propylene	**ACGIH TLV (United States, 3/2017).** TWA: 500 ppm 8 hours. **ACGIH TLV (United States, 1/2005).** TWA: 500 ppm 8 hours. Form: All forms

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]

Color : Colorless.

Odor : Mild.

Odor threshold : Not available.

pH : Not available.

Melting point : -185°C (-301°F)

Boiling point : -48°C (-54.4°F)

Critical temperature : 91.85°C (197.3°F)

Flash point : Closed cup: -107.78°C (-162°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 2%
Upper: 11%

Vapor pressure : 136.6 (psig)

Vapor density : 1.5 (Air = 1)

Specific Volume (ft ^{3}/lb) : 9.0909

Gas Density (lb/ft ^{3}) : 0.11 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.2 g/l

Partition coefficient: n-octanol/water : 1.77

Auto-ignition temperature : 455°C (851°F)

Decomposition temperature : Not available.

Viscosity : Not applicable.

Flow time (ISO 2431) : Not available.

Molecular weight : 42.09 g/mole

Aerosol product

Heat of combustion : -45803592 J/kg

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
propylene	-	3	-

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Section 11. Toxicological information

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
propylene	1.77	-	low

Section 12. Ecological information

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1077	UN1077	UN1077	UN1077	UN1077
UN proper shipping name	PROPYLENE	PROPYLENE	PROPYLENE	PROPYLENE	PROPYLENE
Transport hazard class(es)	2.1	2.1	2.1	2.1	2.1
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Limited quantity** Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 19, T50

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 3000
Passenger Carrying Ship Index Forbidden
Passenger Carrying Road or Rail Index Forbidden
Special provisions 29

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Section 14. Transport information

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Air Act (CAA) 112 regulated flammable substances: propylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	propylene	115-07-1	100
Supplier notification	propylene	115-07-1	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Section 15. Regulatory information

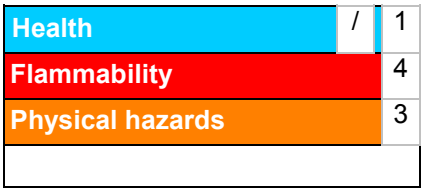
Not listed.

Inventory list

Australia	:	This material is listed or exempted.
Canada	:	This material is listed or exempted.
China	:	This material is listed or exempted.
Europe	:	This material is listed or exempted.
Japan	:	**Japan inventory (ENCS)**: This material is listed or exempted. **Japan inventory (ISHL)**: This material is listed or exempted.
Malaysia	:	Not determined.
New Zealand	:	This material is listed or exempted.
Philippines	:	This material is listed or exempted.
Republic of Korea	:	This material is listed or exempted.
Taiwan	:	This material is listed or exempted.
Thailand	:	Not determined.
Turkey	:	This material is listed or exempted.
United States	:	This material is listed or exempted.
Viet Nam	:	Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Liquefied gas	Expert judgment Expert judgment

Section 16. Other information

History

Date of printing	:	11/30/2017
Date of issue/Date of revision	:	11/30/2017
Date of previous issue	:	No previous validation
Version	:	1
Key to abbreviations	:	ATE = Acute Toxicity Estimate BCF = Bioconcentration Factor GHS = Globally Harmonized System of Classification and Labelling of Chemicals IATA = International Air Transport Association IBC = Intermediate Bulk Container IMDG = International Maritime Dangerous Goods LogPow = logarithm of the octanol/water partition coefficient MARPOL = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution) UN = United Nations
References	:	Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Safety Data Sheet

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Trade Name: Steel
CAS Number: Not applicable
Synonyms: Carbon Steels
Use/Description: Bar, sheet, pipe, tubing, and structural steel products

Manufacturer / Supplier Information:
Steel & Pipe Supply Co., Inc.
555 Poyntz Ave.
Manhattan, KS 66502
Phone: 800-521-2345

Emergency #: 800-424-9300 CHEMTREC

2. HAZARD(S) IDENTIFICATION

Emergency Overview: STEEL PRODUCTS AS SOLD BY SPS ARE NOT HAZARDOUS PER OSHA GHS 29 CFR 1910, 1915, 1926. However, individual customer processes such as welding, sawing, brazing, grinding, abrasive blasting, and machining may result in the formation of fumes, dust (combustible or otherwise), and/or particulate that may present the following hazards:

OSHA Hazards: Carcinogen
Skin Sensitizer
Target Organ Effect – Lungs

GHS Classification: Carcinogenicity (Category 2)
Skin Sensitization (Category 1)
Specific Target Organ Toxicity-Repeated Exposure Category 1)

Pictograms(s):

Signal Word: Danger

Hazard Statement(s):

Dust/fumes may cause an allergic skin reaction
Dust/fumes suspected of causing cancer via inhalation
Inhalation of dust/fumes causes damage to respiratory tract through prolonged or repeated exposure.

Precautionary Statement(s):

Do not handle until all safety precautions have been read and understood.
Avoid breathing dust/fumes.
Use personal protective equipment as required.
If exposed or concerned: Get medical advice/attention.

Potential Health Effects:

Eye Contact - Dusts or particulates may cause mechanical irritation including pain, tearing, and redness. Scratching of the cornea can occur if eye is rubbed. Fumes may be irritating. Contact with the heated material may cause thermal burns.
Skin Contact – Dusts or particulates may cause mechanical irritation due to abrasion. Coated steel may cause skin irritation in sensitive individuals (see Section 16 for additional information). Some components in this product are capable of causing an allergic reaction, possibly resulting in burning, itching and skin eruptions. Contact with heated material may cause thermal burns.
Inhalation – Dusts may cause irritation of the nose, throat, and lungs. Excessive inhalation of metallic fumes and dusts may result in metal fume fever, and influenza-like illness. It is characterized by a sweet or metallic taste in the mouth, accompanied by dryness and irritation of the throat, cough, shortness of breath, pulmonary edema, general malaise, weakness, fatigue, muscle and joint pains, blurred vision, fever and chills. Typical symptoms last from 12 – 48 hours.
Ingestion – Not expected to be acutely toxic via ingestion based on the physical and chemical properties of the product. Swallowing of excessive amounts of the dust may cause irritation, nausea, and diarrhea.
Potential Fire and Explosion Hazards: Under normal conditions, steel products do not present fire or explosion hazards, and dust generated by handling steel products is oxidized and no combustible. Processing of steel products by some individual customers may produce potentially combustible dust that may represent a fire or explosion hazard.
Chronic or Special Toxic Effects – Repeated exposure to fine dusts may inflame the nasal mucosa and cause changes to the lung. In addition, a red=brown pigmentation of the eye and/or skin may occur. Welding fumes have been associated with adverse health effects. Contains components that may cause cancer or reproductive effects. The following components are listed by NTP, OSHA, or IARC as carcinogens: Nickel, chromium (hexavalent), cobalt, lead, cadmium, antimony (trioxide), arsenic, and beryllium. See Section 11 for additional specific information on effects noted above.
Target Organs – Overexposure to specific components of this product that are generated in dusts or fumes may cause adverse effects to the following organs or systems: eyes, skin, liver, kidney, central nervous system, cardiovascular system, respiratory system.
Medical Conditions Aggravated by Exposure: - Diseases of the skin such as eczema may be aggravated by exposure. Also, disorders of the respiratory system including asthma, bronchitis, and emphysema. Long-term inhalation exposure and agents that cause pneumoconiosis (e.g. dust) mat act synergistically with inhalation of oxide fumes or dusts of this product.

3. COMPOSITION/INFORMATION ON INGREDIENTS

CAS#	Component	Percent
1309-37-1	Iron oxide	<97
7439-89-6	Iron	>16.7
7440-47-3	Chromium	0-11
7440-66-6	Zinc	0-10
7440-02-0	Nickel	0-9.5
124-38-9	Carbon dioxide	0-5.5
630-08-0	Carbon monoxide	0-5.5
7440-44-0	Carbon	0-5.5
7439-98-7	Molybdenum	0-5
7440-21-3	Silicon	0-4

7439-96-5	Manganese	0-3
7440-50-8	Copper	0-2.5
7429-90-5	Aluminum	0-2
7704-34-9	Sulfur	0-2
1344-28-1	Aluminum oxide	0-2
7440-69-9	Bismuth	0-1.5
7440-32-6	Titanium	0-1
7440-62-2	Vanadium	0-1
1314-62-1	Vanadium pent oxide	0-1
7440-42-8	Boron	0-0.9
7440-36-0	Antimony	0-0.9
7440-70-2	Calcium	0-0.9
7439-95-4	Magnesium	0-0.9
7727-37-9	Nitrogen	0-0.9
10102-43-9	Nitric oxide	0-0.9
10102-44-0	Nitrogen dioxide	0-0.9
7723-14-0	Phosphorus	0-0.9
7782-49-2	Selenium	0-0.9
7440-31-5	Tin	0-0.9
7440-33-7	Tungsten	0-0.9
7440-03-1	Niobium	0-0.9
13494-80-9	Tellurium	0-0.5

The above listing is a summary of elements used in carbon and alloy steels. Various grades will contain different combinations of the elements. Other trace elements may also be present in minute amounts. These small quantities (less than 0.1%) are frequently referred to as “trace” or “residual” elements; generally they originate in the raw material used. Such elements would include arsenic (As), Beryllium (Be), Cadmium (C0d) cobalt (Co), lead (Pb) mercury (Hg), oil mist (the product may have a light coating of oil to prevent corrosion), oxygen (O), selenium (Se), tellurium (Te), and zirconium (Zr). Various byproducts of processing from these trace elements may include lead chromate, ozone, polybrominated biphenyls (PBB), and polybrominated diphenyl; ether (PBDE), and these byproducts may also be considered trace. If listed in the above table, the ingredient is considered to be a component rather than trace.

Carbon and alloy steel products as provided contain chromium metal in the zero valence state. As such, chromium metal does no present any unusual health hazard. However, welding, torch cutting, brazing, or grinding of chromium metal in carbon and alloy steel may generate airborne concentrations of hexavalent chromium.

4. FIRST AID MEASURES

Eye Contact – In case of overexposure to dusts or fumes, immediately flush eyes with plenty of water for at least 15 minutes occasionally lifting the eye lids. Get medical attention if irritation persists. Thermal burns should be treated as medical emergencies.

Skin Contact – In case of overexposure to dusts or particulates, wash with soap and plenty of water. Get medical attention if irritation develops or persists. If thermal burn occurs. Flush area with cold water and get immediate medical attention.

Inhalation – In case of overexposure to dusts or fumes, remove to fresh air. Get immediate medical attention of symptoms described in the SDS develop.

Ingestion – Not considered an ingestion hazard. However, if excessive amounts of dust or particulates are swallowed, treat symptomatically and supportively. Get medical attention.

Notes to physician – Inhalation of metal fumes or metal oxides may produce an acute febrile state, with cough, chills, weakness, and general malaise, nausea, vomiting, muscle cramps, and remarkable leukocytosis. Treatment is symptomatic, and condition is self-limited in 24-48 hours. Chronic exposure to dusts may result in pneumoconiosis of mixed type.

5. FIRE FIGHTING MEASURES

Flash Point (Method) – Not applicable
Flammable Limits (% volume in air) – Not applicable
Auto ignition Temperature – Not applicable
Extinguishing Media – For molten metal, use dry powder or sand. For steel dust use dry sand, water, foam, argon or nitrogen.
Special Fire Fighting Procedures – Do not use water on molten metal. Do not use Carbon Dioxide. Firefighters should no enter confined spaces without wearing NIOSH/MSHA approved positive pressure breathing apparatus (SCBA) with full mask and full protective equipment.
Unusual Fire or Explosion Hazards – Steel products do not present fire or explosion hazards under normal conditions. Any non-oxidized fine metal particles / dust generated by grinding, sawing, abrasive blasting, or individual customer processes may produce materials that the customer should test for combustibility and other hazards in accordance with applicable regulations. High Concentrations of combustible metallic fines in the air may present an explosion hazard.

6. ACCIDENTAL RELEASE MEASURES

Precautions if Material is Spilled or Released – Emergency response is unlikely unless in the form of combustible dust. Avoid inhalation, eye, or skin contact of dusts by using appropriate precautions outlined in this SDS (see section 8). Fine turnings and small chips should be swept or vacuumed and placed into appropriate disposable containers. Keep fine dust or powder away from sources of ignition. Scrap should be reclaimed for recycling. Prevent materials from entering drains, sewers, or waterways. Specific standards and regulations may be applicable to materials generated by individual customer processes. As appropriate, these standards and regulations should be consulted for applicability.
Fire and Explosion Hazards – Some customer processes may generate combustible dust that may require specific precautions when cleaning spills or releases of dust.
Environmental Precautions – Some grades of steel may contain reportable quantities of alloying elements. See Section 15 for additional information.
Waste Disposal Methods – Dispose of used and unused product in accordance with applicable Federal, State, and Local regulations. Please recycle.

7. HANDLING AND STORAGE

Storage Temperatures – Stable under normal temperatures and pressures.
Precautions to be taken in Handling and Storing – Store away from strong oxidizers. Dusts and/or powders, alone, or combined with process specific fluids, may form explosive mixtures in the air. Applicable Federal, State, and Local laws and regulations may require testing dust generated from processing of steel products to determine if it represents a fire or explosion hazard and to determine appropriate protection methods. Avoid breathing dusts or fumes.

8. EXPOSURE CONTROL / PERSONAL PROTECTION

Operations with potential for generating high concentrations of airborne particulates or fumes should be evaluated and controlled as necessary.
Eye Protection – Use Safety Glasses. Dust resistant safety goggles are recommended under circumstances where particles could cause mechanical injury such as grinding or cutting. Face shield should be used when welding or cutting.
Skin – Appropriate protective gloves should be worn as necessary. Good personal hygiene practices should be followed including cleansing exposed skin several times daily with soap and water and laundering or dry cleaning soiled work clothing.
Respiratory Protection – NIOSH/MSHA approved dust/fume/mist respirator should be used to avoid excessive exposure. See Section 3 for component material information. If such concentrations are sufficiently high that this respirator is inadequate, or high enough to cause oxygen deficiency, use a positive pressure self-contained breathing apparatus (SCBA). Follow all applicable respirator use, fitting, and training standards and regulations.
Ventilation – Provide general and/or local exhaust ventilation to control airborne levels of dust or fumes below exposure limits.
Exposure Guidelines – No permissible exposure limits (PEL) or threshold limit values (TLV exist for steel. See Section 3 for component materials. Various grades of steel will contain different combinations of these elements. Trace elements may also be present in minute amounts.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor – Silver grey to grey black with metallic luster.
Boiling Point – Not applicable
Melting Point – Approximately 2800 degrees F.
pH – Not applicable
Specific Gravity (at 15.6 degrees C) – Not applicable
Density (at 15.6 degrees C) – Not applicable
Vapor Pressure – Not applicable
Vapor Density (air=1) – Not applicable
Solubility in Water – Insoluble
Evaporation Rate (Butyl Acetate=1) – Not applicable
Other Physical and Chemical Data – None

10. STABIITY AND REACTIVITY

Stability – Stable
Conditions to avoid – Steel at temperatures above the melting point may liberate fumes containing oxides of iron and alloying elements. Avoid generation of airborne fume.
Hazardous Polymerization – Will not occur
Incompatibility (Materials to Avoid) – Reacts with strong acids to form hydrogen gas. Do not store near strong oxidizers.
Hazardous Decomposition Products – Metallic fumes may be produced during welding, burning, grindings, and possibly machining or any situation with the potential for thermal decomposition. Refer to ANSI Z49.1.

11. TOXICOLOGICAL INFORMATION

The primary component of this product is iron. Long-term exposure to iron dusts or fumes can result in a condition called siderosis which is considered to be a benign pneumoconiosis. Symptoms may include chronic bronchitis, emphysema, and shortness of breath upon exertion. Penetration of iron particles in the skin or eye may cause an exogenous or ocular siderosis which may be characterized by a red-brown pigmentation of the affected area. Ingestion overexposures to iron may affect the gastrointestinal, nervous, and hematopoietic system and the liver. Iron and steel founding, but not iron or iron oxide, has been listed as carcinogenic (Group 1) by IARC.

When this product is welded, fumes are generated. Welding fumes may be different in composition from the original welding product, with the chief component being ordinary oxides of the metal being welded. Chronic health effects (including cancer) have been associated with the fumes and dusts of individual component metals and welding fumes as a general category have been listed by IARC as a carcinogen (Group 2B). There is also limited evidence that welding fumes may cause adverse reproductive and fetal effects. Evidence is stronger where welding materials contain known reproductive toxins, e.g., lead, which may be present in the coating material of this product.

Breathing fumes or dusts of this product may result in metal fume fever, which is an illness produced by inhaling metal oxides. These oxides are produced by heating various metals including cadmium, zinc, magnesium, copper, antimony, nickel, cobalt, manganese, tin, lead, beryllium, silver, chromium, aluminum, selenium, iron, and arsenic. The most common agents involved are zinc and copper.

This product may contain small amounts of manganese. Prolonged exposure to manganese dusts or fumes is associated with “manganism”, a Parkinson-like syndrome characterized by a variety of neurological symptoms including muscle spasms, gait disturbances, tremors, and psychoses.

This product may contain small amounts of cadmium. Primary target organs of cadmium overexposure are the lung and the kidney. Because of its cumulative nature, chronic cadmium poisoning can cause serious disease which takes many years to develop and may continue to progress despite cessation of exposure. Progression of the disease may not reflect current exposure conditions. It is also capable of causing painful osteomalacia called “Itai-Itai” in postmenopausal women, and has caused developmental effects and/or reproductive effects in male and female animals. Cadmium is a listed carcinogen by NTP, OSHA, and IARC (Group 1).

This product may contain small amounts of chromium. Prolonged and repeated overexposure to chromium dusts or fumes may cause skin ulcers, nasal irritation and ulceration, kidney damage and cancer of the respiratory system. Chromium is a

skin sensitizer. Cancer is general attributed to the hexavalent (+6) form of chromium which is listed as a carcinogen by NTP and IARC (Group 1).

This product may contain small amounts of nickel. Prolonged and repeated contact with nickel may cause sensitization dermatitis. Inhalation of nickel compounds has caused lung damage as well as sinus, nasal and lung cancer in laboratory animals. Nickel is a listed carcinogen by NTP and IARC (Group 1).

This product may contain small amounts of vanadium. Adverse effects from dermal, inhalation or parenteral exposure to various vanadium compounds have been reported. The major target for vanadium pent oxide toxicity is the respiratory tract. Fumes or dust can cause severe eye and respiratory irritation, and systemic effects. Chronic bronchitis, green tongue, conjunctivitis, pharyngitis, rhinitis, rales, chronic productive cough, and tightness of the chest have been reported following exposure. Allergic reactions resulting from skin and inhalation exposures have also been reported. A statistical association between vanadium air levels and lung cancer has been suggested, but vanadium currently is not regarded as a human carcinogen.

This product may contain small amounts of lead. Lead can accumulate in the body. Consequently, exposure to fumes or dust may produce signs of polyneuritis, diminished vision and peripheral neuropathy, such as tingling and loss of feeling in the fingers, arms and legs. Lead is a known reproductive and developmental toxin. It is also associated with central nervous system disorders, anemia, and kidney dysfunction and neurobehavioral abnormalities. The brain is a major target organ for lead exposure. Elemental lead is list as an IARC 2B carcinogen.

This product may contain small amounts of copper. Copper dust and fumes can irritate the eyes, nose and throat causing coughing, wheezing, nosebleeds, ulcers, and metal fume fever. Other effects from repeated inhalation of copper fumes include a metallic or sweet taste and discoloration of skin, teeth or hair. Copper also may cause an allergic skin reaction. Overexposure to copper can affect the liver.

12. ECOLOGICAL INFORMATION

Aquatic Ecotoxicological Data – No specific information available on this product.
Environmental Fate Data – Np specific information available on this product.

13. DISPOSAL CONSIDERATIONS

Recovery and reuse, rather than disposal, should be the ultimate goal of handling efforts. Disposal in accordance with federal, state, and local health and environmental regulations. Prevent materials from entering drains, sewers, or waterways.

14. TRANSPORT INFORMATION

DOT Proper Shipping Name – Not regulated
DOT Hazard Classification – Not regulated
UN/NA Number – Not applicable
DOT Packing Group – Not applicable
Labeling Requirements – Not applicable
Placards – Not applicable
DOT Hazardous Substance – Not applicable
DOT Marine Pollutant – Not applicable

15. REGULATORY INFORMATION

This product is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200. However, dusts and fumes from this product may be combustible or hazardous and require protection to comply with applicable Federal state and local laws and regulations.

California Proposition 65: This product contains chemicals (antimony [oxide], arsenic, beryllium, chromium [hexavalent], cobalt, cadmium, lead, nickel) known to the State of California to cause cancer and chemicals (cadmium, lead) known to the State of California to cause birth defects or other reproductive harm.

Massachusetts Substance List: Aluminum, Antimony, Arsenic, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Lead, Magnesium, Manganese, Molybdenum, Nickel, Nitrogen, Phosphorus, Selenium, Silicon, Sulfur, Tin, Titanium, Tungsten, Vanadium, Zinc.
Pennsylvania Hazardous Substance List: Aluminum, Antimony, Arsenic, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Lead, Magnesium, Manganese, Molybdenum, Nickel, Nitrogen, Phosphorus, Selenium, Silicon, Sulfur, Tin, Tungsten, Vanadium, Zinc.
New Jersey Hazardous Substance List: Aluminum, Antimony, Arsenic, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Lead, Magnesium, Manganese, Molybdenum, Nickel, Nitrogen, Phosphorus, Selenium, Silicon, Sulfur, Tin, Tungsten, Vanadium, Zinc.

Toxic Substances Control Act (TSCA): Components of this product are listed in the TSCA inventory.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA): Steel is not reportable, however, it contains hazardous substances that may be reportable if released in pieces with diameters less than or equal to .004 inches (RQ marked with a "*").

Chemical Name	Reportable Quantity (in lb)
Antimony	5000*
Arsenic	1*
Beryllium	10*
Cadmium	10*
Chromium	5000*
Copper	5000*
Lead	10*
Nickel	100*
Phosphorus	1
Selenium	100*
Zinc	1000*

Superfund Amendments and Reauthorization Act of 1985 (SARA), Title III
SECTION 311/312 HZARD CATAGORIES: Immediate Health Effect, Delayed Health Effect

This product contains the following EPCRA Section 313 chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right – to – Know Act of 1986 (40 CFR 372):

SECTION 313 REPORTABLE INGREDIENTS:

Chemical Name	CAS Number	Concentration (% by weight)	Reportable
Aluminum	7429-90-5	<0.05	No – Less than 1%
Antimony	7440-36-0	<0.9	No – Less than 1%
Arsenic	7440-38-2	<0.09	No – Less than 0.1%
Beryllium	7440-41-7	<0.09	No – Less than 0.1%
Cadmium	7440-43-9	<0.09	No – Less than 0.1%
Chromium	7440-47-3	0.01-1.0	Yes – Greater than 0.1%
Cobalt	7440-48-4	<0.09	No – Less than 0.1%
Copper	7440-50-8	<0.9	No – Less than 1%
Lead	7439-92-1	<0.05	Yes
Manganese	7439-96-5	02.-2	Yes – Greater than 1%
Nickel	7440-02-0	<1	Yes – Greater than 0.1%
Phosphorus	7723-14-0	<0.9	No – Less than 1%
Selenium	7782-49-2	<0.9	No – Less than 1%
Vanadium	7440-62-2	<0.9	No – Less than 1%
Zine	7440-66-6	0-0.1	No – Less than 1%

Concentrations based on analytical data and process knowledge of typical products reported by suppliers.

16. OTHER INFORMATION

This SDS covers steel as delivered from a SPS facility but does not include chemicals that may be applied by subsequent handlers and/or distributors of this product. This could include a variety of material including oil, paints, galvanization, etc. that are not included in this SDS. Additionally, specialty orders may require application of coating material not listed in this SDS. SDSs for any coating will be provided separately on request. During welding, precautions should be taken for airborne contaminants that may originate from components if the welding rod. Arc or spark generated when welding or burning could be a source of ignition for combustible and/or flammable materials. The information in the SDS was obtained from sources which we believe are reliable; however, the information is provided without and representation of warranty, expressed or implied, regarding the accuracy or correctness. The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage, or expense arising out of or in any way connected with the handling, storage, use, or disposal of this product.

BIOBLEND™
High Performance BioBased Lubricants

SAFETY DATA SHEET

SECTION 1: IDENTIFICATION

Company Information:

BioBlend Renewable Resources, LLC
2250 Arthur Ave.
Elk Grove Village, IL 60007
(630) 227-1800
www.bioblend.com

Emergency Contact Information:

(630) 227-1800
8 AM - 4 PM, Monday through Friday

Product Name	**BioLube TJC**
Product Description	**Biodegradable Thread Joint Compound**
Product Use	**Product is intended for use as an industrial lubricating grease.**

SECTION 2: HAZARD(S) IDENTIFICATION

Hazard Statement	**This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard, which has been updated to align with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).**
Precautionary Statements	**Not applicable**
Hazard Classification	**Not applicable**
Hazards not otherwise classified	**None known**
Unknown Toxicity Statement	**0% of the mixture consists of ingredients with unknown toxicity**

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS No.	Weight %
Silica, crystalline (quartz)	14808-60-7	<1%

The exact percentage (concentration) of composition has been withheld as a trade secret. If CAS number is indicated as "PROPRIETARY" or "MIXTURE", information has been withheld as a trade secret.

SECTION 4: FIRST AID MEASURES

First Aid - Inhalation	**Move to fresh air in case of accidental inhalation of vapors. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Consult a physician.**
First Aid - Eye Contact	**Rinse eyes and under eyelids immediately with water for at least 15 minutes.**
First Aid - Skin Contact	**Wash effected area immediately with soap and water. Remove and wash contaminated clothing before re-use.**
First Aid - Ingestion	**If swallowed, seek medical attention immediately and show product container or Safety Data Sheet to appropriate individuals. Do not induce vomiting without medical advice. Never give anything by mouth to an unconscious person.**
Recommendations for immediate medical care/special treatment	**Physicians should treat symptomatically.**

SECTION 5: FIREFIGHTING MEASURES

Suitable extinguishing media	**Dry chemical, CO2, water spray or 'alcohol' foam**
Unsuitable extinguish-ing media	**None known**
Specific hazards that may develop	**None known**

Special firefighting equipment/precautions	**Firefighters should use all standard protective gear including a self contained breathing apparatus pressure-demand, MSHA/OSHA (approved or equivalent) and full protective gear. Water mist may be used to cool closed containers.**

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal precautions	**Ensure adequate ventilation. Do not breathe vapor/dust. Use personal protective equipment and avoid contact with skin, eyes, and clothing. Wash thoroughly after handling.**
Emergency procedures	**None Known**
Methods and material for containment	**Use inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust) as directed by manufacturer for containment of spills.**
Cleanup procedures	**Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Sweep up and shovel into suitable containers for disposal.**

SECTION 7: HANDLING AND STORAGE

Precautions for safe handling	**Provide sufficient air exchange and/or exhaust in work rooms. In the case of insufficient ventilation, wear suitable respiratory equipment. Do not breath spray mist or vapors. Wear recommended personal protective equipment to avoid contact with eyes, skin and clothing and wash thoroughly after handling.**
Storage recommen-dations	**Store at room temperature in the original container away from incompatible materials and potential sources of ignition.**

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits

Components	ACGIH Exposure Limits	OSHA TWA (final)	NIOSH - Pocket Guide
Calcium carbonate (limestone)	None	15 mg/m³	10 mg/m³ (TWA) 5 mg/m³ (TWA)
Silica, crystalline (quartz)	0.025 mg/m³ (TWA)	None	0.05 mg/m³ (TWA)

Engineering controls	**Ensure adequate ventilation**

Recommended Personal Protective Equipment:

Eye/Face Protection	**Safety glasses with side shields are recommended.**
Respiratory Protection	**If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, a NIOSH-certified respirator with**

	organic vapor/P100 filter should be worn.
Skin/Body Protection	Long sleeved clothing should be worn when handling product, along with neoprene, latex, nitrile, butyl rubber or polyethylene type gloves.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Opaque Tan
Odor	Mild
Odor Threshold	No information available
pH	Not applicable
Melting Point/ Freezing Point	No information available
Initial Boiling Point/ Range	No information available
Flash Point	>285C/550F
Evaporation rate	No information available
Flammability	No information available
Flammability, upper limits	No information available
Flammability, lower limits	No information available
Vapor pressure	No information available
Vapor density	No information available
Relative density	No information available
Solubility(ies)	No information available

Solubility in water	**Insoluble**
Partition coefficient: n-octanol/water	**No information available**
Auto-ignition temperature	**No information available**
Decomposition temperature	**No information available**
Viscosity @ 40C, cSt	**42 mm²/s**

SECTION 10: STABILITY AND REACTIVITY

Reactivity	**This product is stable and non-reactive under normal conditions of use, storage, handling and transportation.**
Stability	**This product is chemically stable under normal conditions of use, storage, handling and transportation.**
Possibility of hazardous reactions	**Hazardous polymerization will not occur.**
Conditions to avoid	**None known**
Incompatible materials	**Strong oxidizing agents**
Hazardous decomposition products	**Carbon oxides**

SECTION 11: TOXICOLOGICAL INFORMATION

Potential health effects:

Inhalation	**May cause irritation of respiratory tract**
Eye contact	**Contact with eyes may cause irritation**
Skin contact	**Prolonged contact may cause redness and irritation**

Ingestion	**Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.**

Symptoms or effects, including acute and delayed:

Inhalation	**None known or expected under normal use.**
Eye Contact	**None known or expected under normal use.**
Skin Contact	**None known or expected under normal use.**
Ingestion	**None known or expected under normal use.**

Toxicological effects:

Sensitization	No information available
Mutagenic effects	No information available
Reproductive Toxicity	No information available
Developmental Toxicity	No information available
Teratogenic	No information available
STOT - single exposure	No information available
STOT - repeated exposure	No information available
Aspiration Hazard	No information available

NTP Report on Carcinogens	**Known carcinogen - This product contains crystalline silica (quartz) in a non-respirable form. Inhalation of crystalline silica is unlikely to occur from exposure to this product.**
IARC listing of potential carcinogens	**Group 1 (Carcinogenic to Humans) - This product contains crystalline silica (quartz) in a non-respirable form. Inhalation of crystalline silica is unlikely to occur from exposure to this product.**
OSHA listing of potential carcinogens	**Present - This product contains crystalline silica (quartz) in a non-respirable form. Inhalation of crystalline silica is unlikely to occur from exposure to this product.**

SECTION 12: ECOLOGICAL INFORMATION

OECD 301B Biodegradability	**>80%**

Bioaccumulation	**Information not available**
OECD 201 Alga, EC50, 72hr, mg/L	**Not Available**
OECD 202 Daphnia, EC50, 48hr, mg/L	**Not Available**
OECD 203 Fish, LC50, 96hr, mg/L	**Not Available**

SECTION 13: DISPOSAL CONSIDERATIONS

Disposal consider-ations	**Dispose of contents and container in accordance with all international, federal, state, regional and local regulations.**
Waste from residues/ unused products	**Dispose of waste from residues/unused product in accordance with all international, federal, state, regional and local regulations. This product, if Oil soaked materials may spontaneously combust and should be properly managed to avoid ignition and heat sources or oxygen rich environments. Collect and store soaked materials in closed metal containers to help prevent combustion.**
Contaminated packaging	**Do not re-use empty containers**

SECTION 14: TRANSPORT INFORMATION

US DOT	**Not regulated**
TDG (Canada)	**Not regulated**
ICAO	**Not regulated**
IMDG	**Not regulated**
IATA	**Not regulated**

SECTION 15: REGULATORY INFORMATION

US TSCA Inventory	**This product complies with TSCA inventory.**
California Prop. 65	**Listed component present: Silica, crystalline (quartz) - Carcinogen**
SARA Extremely Hazardous Substances	**Not listed**
SARA Section 313	**Not listed**
CERCLA Hazardous Substances	**No reportable quantity for this product or its components**

SECTION 16: OTHER INFORMATION

Revision date	**6_28_2018**

This product's safety information is provided to assist our customers in assessing compliance with safety, health and environmental regulations. The information contained within this document is based on data available to us and is believed to be accurate at the time of last revision. However, no warranty of use or any other warranty is expressed or implied regarding the accuracy of this data, the results to be obtained from the use thereof, or the hazards connected with the use of this product. Whereas the use of this product is within the exclusive control of the user, it is the user's obligation to determine the conditions for safe use of this product. Such conditions must comply with with all regulations concerning this product. BioBlend Renewable Resources, LLC assumes no liability for any injury or damage, direct or consequential, resulting from the use of this product unless such injury or damage is attributable to gross negligence on the part of BioBlend Renewable Resources, LLC.

SAFETY DATA SHEET

1. Identification

Product identifier **Oatey Purple Primer- NSF Listed for PVC and CPVC**

Other means of identification

SDS number 1402C

Synonyms Part Numbers: 30755(TV), 30756(TV), 30757(TV), 30758, 30759, 30927, 31480, 31481, 31482, 31483

Recommended use Joining PVC Pipes

Recommended restrictions None known.

	Manufacturer	Distributor
Company Name	Oatey Co.	Oatey Canada Supply Chain Services Co.
Address	4700 West 160th St. Cleveland, OH 44135	145 Walker Drive Brampton, ON L6T 5P5, Canada

Telephone 216-267-7100

E-mail info@oatey.com

Transport Emergency Chemtrec 1-800-424-9300 (Outside the US 1-703-527-3887)

Emergency First Aid 1-877-740-5015

Contact person MSDS Coordinator

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 2
	Physical hazards not otherwise classified	Category 1
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 2A
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
	Aspiration hazard	Category 1
	Health hazards not otherwise classified	Category 1

Environmental hazards Not classified.

Label elements

Signal word Danger

Hazard statement Highly flammable liquid and vapor. Harmful if swallowed. May be fatal if swallowed and enters airways. Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation. May cause drowsiness or dizziness.

Precautionary statement

Prevention Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting/equipment. Use non-sparking tools. Take action to prevent static discharges. Avoid breathing mist or vapor. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.

Response	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a POISON CENTER or doctor/physician if you feel unwell. Rinse mouth. Do NOT induce vomiting. Take off contaminated clothing and wash it before reuse. In case of fire: Use appropriate media to extinguish.
Storage	Keep cool. Store in a well-ventilated place. Keep container tightly closed. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Other hazards	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis. May form explosive peroxides.
Supplemental information	Not applicable.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Acetone	67-64-1	25-40
Cyclohexanone	108-94-1	25-40
Methyl ethyl ketone	78-93-3	15-30

All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.
Skin contact	Take off immediately all contaminated clothing. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
Ingestion	Call a physician or poison control center immediately. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Aspiration may cause pulmonary edema and pneumonitis.
Most important symptoms/effects, acute and delayed	Irritation of nose and throat. Aspiration may cause pulmonary edema and pneumonitis. Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause respiratory irritation. Vapors have a narcotic effect and may cause headache, fatigue, dizziness and nausea. Skin irritation. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off all contaminated clothing immediately. IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Alcohol resistant foam. Water fog. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Vapors may form explosive mixtures with air. Vapors may travel considerable distance to a source of ignition and flash back. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials. Cool containers exposed to flames with water until well after the fire is out.
General fire hazards	Highly flammable liquid and vapor. This product contains tetrahydrofuran that may form explosive organic peroxide when exposed to air or light or with age.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Wear appropriate protective equipment and clothing during clean-up. Avoid inhalation of vapors or mists. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up

Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Take precautionary measures against static discharge. Use only non-sparking tools. Keep combustibles (wood, paper, oil, etc.) away from spilled material.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Use water spray to reduce vapors or divert vapor cloud drift. Following product recovery, flush area with water.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use. This product is miscible in water. For waste disposal, see section 13 of the SDS.

Environmental precautions

Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling

Vapors may form explosive mixtures with air. Do not handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. Do not taste or swallow. Avoid breathing mist or vapor. Avoid contact with skin. Avoid contact with eyes. Avoid prolonged exposure. Avoid contact with clothing. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. When using, do not eat, drink or smoke. Wash hands thoroughly after handling.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep away from heat, sparks and open flame. Prevent electrostatic charge build-up by using common bonding and grounding techniques. Store in original tightly closed container. Store in a cool, dry place out of direct sunlight. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS). Keep in an area equipped with sprinklers.

8. Exposure controls/personal protection

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	500 ppm
	TWA	250 ppm
Cyclohexanone (CAS 108-94-1)	STEL	50 ppm
	TWA	20 ppm
Methyl ethyl ketone (CAS 78-93-3)	STEL	300 ppm
	TWA	200 ppm

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	1800 mg/m3
		750 ppm
	TWA	1200 mg/m3
		500 ppm
Cyclohexanone (CAS 108-94-1)	STEL	200 mg/m3
		50 ppm
	TWA	80 mg/m3
		20 ppm

Canada. Alberta OELs (Occupational Health & Safety Code, Schedule 1, Table 2)

Components	Type	Value
Methyl ethyl ketone (CAS 78-93-3)	STEL	885 mg/m3
		300 ppm
	TWA	590 mg/m3
		200 ppm

Canada. British Columbia OELs. (Occupational Exposure Limits for Chemical Substances, Occupational Health and Safety Regulation 296/97, as amended)

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	500 ppm
	TWA	250 ppm
Cyclohexanone (CAS 108-94-1)	STEL	50 ppm
	TWA	20 ppm
Methyl ethyl ketone (CAS 78-93-3)	STEL	100 ppm
	TWA	50 ppm

Canada. Manitoba OELs (Reg. 217/2006, The Workplace Safety And Health Act)

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	500 ppm
	TWA	250 ppm
Cyclohexanone (CAS 108-94-1)	STEL	50 ppm
	TWA	20 ppm
Methyl ethyl ketone (CAS 78-93-3)	STEL	300 ppm
	TWA	200 ppm

Canada. Ontario OELs. (Control of Exposure to Biological or Chemical Agents)

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	750 ppm
	TWA	500 ppm
Cyclohexanone (CAS 108-94-1)	STEL	50 ppm
	TWA	20 ppm
Methyl ethyl ketone (CAS 78-93-3)	STEL	300 ppm
	TWA	200 ppm

Canada. Quebec OELs. (Ministry of Labor - Regulation Respecting the Quality of the Work Environment)

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	2380 mg/m3
		1000 ppm
	TWA	1190 mg/m3
		500 ppm
Cyclohexanone (CAS 108-94-1)	TWA	100 mg/m3
		25 ppm
Methyl ethyl ketone (CAS 78-93-3)	STEL	300 mg/m3
		100 ppm
	TWA	150 mg/m3
		50 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Acetone (CAS 67-64-1)	25 mg/l	Acetone	Urine	*
Cyclohexanone (CAS 108-94-1)	80 mg/l	1,2-Cyclohexanediol, with hydrolysis	Urine	*
	8 mg/l	Cyclohexanol, with hydrolysis	Urine	*
Methyl ethyl ketone (CAS 78-93-3)	2 mg/l	MEK	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines

Canada - Alberta OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Canada - British Columbia OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Canada - Manitoba OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Canada - Ontario OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Canada - Quebec OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Canada - Saskatchewan OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Appropriate engineering controls Explosion-proof general and local exhaust ventilation. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Wear appropriate chemical resistant gloves.

Other Wear appropriate chemical resistant clothing.

Respiratory protection If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Physical state Liquid.

Form Translucent liquid.

Color Purple

Odor Solvent.

Odor threshold Not available.

pH Not available.

Melting point/freezing point Not available.

Initial boiling point and boiling range 151 °F (66.11 °C)

Flash point	14.0 - 23.0 °F (-10.0 - -5.0 °C)
Evaporation rate	5.5 - 8
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	1.8
Flammability limit - upper (%)	11.8
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	145 mm Hg @ 20 C
Vapor density	2.5
Relative density	0.84 +/- 0.02 @20°C
Solubility(ies)	
Solubility (water)	Negligible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Bulk density	7 lb/gal
VOC (Weight %)	505 g/l SQACMD Method 24

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid heat, sparks, open flames and other ignition sources. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Acids. Strong oxidizing agents. Ammonia. Amines. Isocyanates. Caustics.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May be fatal if swallowed and enters airways. May cause irritation to the respiratory system. Vapors have a narcotic effect and may cause headache, fatigue, dizziness and nausea. Prolonged inhalation may be harmful.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye irritation.
Ingestion	May be fatal if swallowed and enters airways. Harmful if swallowed.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Aspiration may cause pulmonary edema and pneumonitis. Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Skin irritation. May cause redness and pain. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Information on toxicological effects

Acute toxicity	May be fatal if swallowed and enters airways. Narcotic effects. May cause respiratory irritation.

Components	Species	Test Results
Acetone (CAS 67-64-1)		
Acute		
Dermal		
LD50	Rabbit	20 ml/kg
Inhalation		
LC50	Rat	50 mg/l, 8 Hours
Oral		
LD50	Rat	5800 mg/kg
Cyclohexanone (CAS 108-94-1)		
Acute		
Dermal		
LD50	Rabbit	948 mg/kg
Inhalation		
LC50	Rat	8000 ppm, 4 hours
Oral		
LD50	Rat	800 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Causes serious eye irritation.

Respiratory or skin sensitization

Respiratory sensitization Not available.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity In 2012 USEPA Integrated Risk Information System (IRIS) reviewed a two species inhalation lifetime study on THF conducted by NTP (1998). Male rats developed renal tumors and female mice developed liver tumors while neither the female rats nor the male mice showed similar results. Because the carcinogenic mechanisms could not be identified clearly in either species for either tumor, the EPA determined that the male rat and female mouse findings are relevant to the assessment of carcinogenic potential in humans. Therefore, the IRIS review concludes that these data in aggregate indicate that there is "suggestive evidence of carcinogenic potential" following exposure to THF by all routes of exposure.

ACGIH Carcinogens

Acetone (CAS 67-64-1)	A4 Not classifiable as a human carcinogen.
Cyclohexanone (CAS 108-94-1)	A3 Confirmed animal carcinogen with unknown relevance to humans.

Canada - Manitoba OELs: carcinogenicity

ACETONE (CAS 67-64-1)	Not classifiable as a human carcinogen.
CYCLOHEXANONE (CAS 108-94-1)	Confirmed animal carcinogen with unknown relevance to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Cyclohexanone (CAS 108-94-1)	3 Not classifiable as to carcinogenicity to humans.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Narcotic effects. Respiratory tract irritation.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Prolonged inhalation may be harmful.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Acetone (CAS 67-64-1)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	> 100 mg/l, 96 hours
Cyclohexanone (CAS 108-94-1)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	481 - 578 mg/l, 96 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Partition coefficient n-octanol / water (log Kow)

Acetone (CAS 67-64-1)	-0.24
Cyclohexanone (CAS 108-94-1)	0.81
Methyl ethyl ketone (CAS 78-93-3)	0.29

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. This material and its container must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

TDG

UN number UN1993
UN proper shipping name FLAMMABLE LIQUID, N.O.S. (Methyl ethyl ketone, Acetone)
Transport hazard class(es)
Class 3
Subsidiary risk -
Packing group II
Environmental hazards D
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IATA

UN number UN1993
UN proper shipping name Flammable liquid, n.o.s. (Methyl ethyl ketone, Acetone)
Transport hazard class(es)
Class 3
Subsidiary risk -
Packing group II
Environmental hazards No.
ERG Code 3H
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number UN1993
UN proper shipping name FLAMMABLE LIQUID, N.O.S. (Methyl ethyl ketone, Acetone)

Transport hazard class(es)

Class	3
Subsidiary risk	-
Packing group	II
Environmental hazards	
Marine pollutant	No.
EmS	F-E, S-E
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not available.

15. Regulatory information

Canadian regulations This product has been classified in accordance with the hazard criteria of the HPR and the SDS contains all the information required by the HPR.

Controlled Drugs and Substances Act

Not regulated.

Export Control List (CEPA 1999, Schedule 3)

Not listed.

Greenhouse Gases

Not listed.

Precursor Control Regulations

Acetone (CAS 67-64-1)	Class B
Methyl ethyl ketone (CAS 78-93-3)	Class B

International regulations

Stockholm Convention

Not applicable.

Rotterdam Convention

Not applicable.

Kyoto protocol

Not applicable.

Montreal Protocol

Not applicable.

Basel Convention

Not applicable.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other Information

Issue date	21-December-2015
Revision date	-
Version #	01
Disclaimer	Oatey Co. cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **HOLEPLUG® 3/4**

Revision Date: 14-Aug-2017 **Revision Number:** 17

1. Identification

1.1. Product Identifier

Product Trade Name:	HOLEPLUG® 3/4
Synonyms	None
Chemical Family:	Mineral
Internal ID Code	HM003666

1.2 Recommended use and restrictions on use

Application:	Fluid Loss Additive
Uses advised against	No information available

1.3 Manufacturer's Name and Contact Details

Manufacturer/Supplier

Baroid Fluid Services
Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000

Halliburton Energy Services, Inc.
645 - 7th Ave SW Suite 1800
Calgary, AB
T2P 4G8
Canada

Prepared By Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

1.4. Emergency telephone number:

Emergency Telephone Number 1-866-519-4752 or 1-760-476-3962
Global Incident Response Access Code: 334305
Contract Number: 14012

2. Hazards Identification

2.1 Classification in accordance with paragraph (d) of §1910.1200

Carcinogenicity	Category 1A - H350
Specific Target Organ Toxicity - (Repeated Exposure)	Category 2 - H373

2.2. Label Elements

Hazard Pictograms

Signal Word: Danger

Hazard Statements
H350 - May cause cancer by inhalation
H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

Precautionary Statements

Prevention
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P280 - Wear protective gloves/eye protection/face protection

Response
P308 + P313 - IF exposed or concerned: Get medical advice/attention
P314 - Get medical attention/advice if you feel unwell

Storage
P405 - Store locked up

Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

2.3 Hazards not otherwise classified

This product contains Wyoming bentonite or other sorptive clays. Crystalline silica forms found in this particular clay are limited to quartz. Extreme temperatures that can generate cristobalite or tridymite are not expected to occur under realistic conditions. In addition, all quartz found in sorptive clays are considered "occluded", i.e., strongly coated with an amorphous silica surface. Occluded quartz has been experimentally-determined to be relatively non-toxic compared to unoccluded quartz. A lack of health effects found in several studies examining occupational exposure to sorptive clays also suggest that chronic inhalation of sorptive clays is not expected to result in silicosis or cancer. In light of these findings OSHA has recently exempted Wyoming bentonite and other sorptive clays from the crystalline silica PEL in §1910.1053(a)(1)(iii).

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - US
Crystalline silica, quartz	14808-60-7	1 - 5%	Carc. 1A (H350) STOT RE 1 (H372)

The exact percentage (concentration) of the composition has been withheld as proprietary.

4. First Aid Measures

4.1. Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

4.2 Most important symptoms/effects, acute and delayed

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. Fire-fighting measures

5.1. Extinguishing media

Suitable Extinguishing Media

All standard fire fighting media

Extinguishing media which must not be used for safety reasons

None known.

5.2 Specific hazards arising from the substance or mixture

Special exposure hazards in a fire

Not applicable

5.3 Special protective equipment and precautions for fire-fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust.

See Section 8 for additional information

6.2. Environmental precautions

None known.

6.3. Methods and material for containment and cleaning up

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 60 months.

8. Exposure Controls/Personal Protection

8.1 Occupational Exposure Limits

Substances	CAS Number	OSHA PEL-TWA	ACGIH TLV-TWA
Crystalline silica, quartz	14808-60-7	TWA: 50 µg/m³	TWA: 0.025 mg/m³

Exposures to crystalline silica that result from bentonite or other sorptive clays are exempt from the PEL in §1910.1053. The PEL in §1910.1000 Table Z–3 (i.e., the formula that is approximately equivalent to 100 µg/m³) applies to occupational exposures to respirable crystalline silica from sorptive clays.

8.2 Appropriate engineering controls

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

8.3 Individual protection measures, such as personal protective equipment

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (N95, P2/P3)

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Solid
Odor: Mild earthy
Color Tan to Gray
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	7.5
Freezing Point / Range	No data available
Melting Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Flammability (solid, gas)	No data available
Upper flammability limit	No data available
Lower flammability limit	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	2.12
Water Solubility	Insoluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity
Not expected to be reactive.

10.2. Chemical stability
Stable

10.3. Possibility of hazardous reactions
Will Not Occur

10.4. Conditions to avoid
None anticipated

10.5. Incompatible materials
Hydrofluoric acid.

10.6. Hazardous decomposition products
Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. Toxicological Information

11.1 Information on likely routes of exposure

Principle Route of Exposure Eye or skin contact, inhalation.

11.2 Symptoms related to the physical, chemical and toxicological characteristics

Acute Toxicity

Inhalation Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause mechanical irritation to eye.

Skin Contact None known.

Ingestion None known.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology

Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

This product contains Wyoming bentonite or other sorptive clays. Crystalline silica forms found in this particular clay are limited to quartz. Extreme temperatures that can generate cristobalite or tridymite are not expected to occur under realistic conditions. In addition, all quartz found in sorptive clays are considered "occluded", i.e., strongly coated with an amorphous silica surface (Wendlandt et al., 2007; Hochella and Muryama, 2010; SMI, 2014). Occluded quartz has been experimentally-determined to be relatively non-toxic compared to unoccluded quartz (Geh et al., 2006; Creutzenberg et al., 2008). A lack of health effects found in several studies examining occupational exposure to sorptive clays also suggest that chronic inhalation of sorptive clays is not expected to result in silicosis or cancer (Waxweiler et al., 1988; ACGIH, 1991; USEPA, 1996; IARC, 2005). In light of these findings OSHA has recently exempted Wyoming bentonite and other sorptive clays from the crystalline silica PEL in §1910.1053(a)(1)(iii).

11.3 Toxicity data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, quartz	14808-60-7	> 15000 mg/kg (human)	No data available	No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the eye

Substances	CAS Number	Skin Sensitization
Crystalline silica, quartz	14808-60-7	No information available.

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, quartz	14808-60-7	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, quartz	14808-60-7	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, quartz	14808-60-7	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, quartz	14808-60-7	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, quartz	14808-60-7	Not applicable

12. Ecological Information

12.1. Toxicity

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, quartz	14808-60-7	EC50 (72 h) =440 mg/L (Selenastrum capricornutum)(similar substance)	LL0 (96 h) =10000 mg/L (Danio rerio)(similar substance)	No information available	LL50 (24 h) >10000 mg/L (Daphnia magna)(similar substance)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Crystalline silica, quartz	14808-60-7	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Crystalline silica, quartz	14808-60-7	No information available

12.5 Other adverse effects

No information available

13. Disposal Considerations

13.1. Waste treatment methods

Disposal methods If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. Transport Information

US DOT

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

Canadian TDG

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable
Special Precautions for User None

15. Regulatory Information

US Regulations

US TSCA Inventory All components listed on inventory or are exempt.

TSCA Significant New Use Rules - S5A2

Substances	CAS Number	TSCA Significant New Use Rules - S5A2
Crystalline silica, quartz	14808-60-7	Not applicable

EPA SARA Title III Extremely Hazardous Substances

Substances	CAS Number	EPA SARA Title III Extremely Hazardous Substances
Crystalline silica, quartz	14808-60-7	Not applicable

EPA SARA (311,312) Hazard Class
Chronic Health Hazard

EPA SARA (313) Chemicals

Substances	CAS Number	Toxic Release Inventory (TRI) - Group I	Toxic Release Inventory (TRI) - Group II
Crystalline silica, quartz	14808-60-7	Not applicable	Not applicable

EPA CERCLA/Superfund Reportable Spill Quantity

Substances	CAS Number	CERCLA RQ
Crystalline silica, quartz	14808-60-7	Not applicable

EPA RCRA Hazardous Waste Classification
If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.

California Proposition 65

Substances	CAS Number	California Proposition 65
Crystalline silica, quartz	14808-60-7	carcinogen

U.S. State Right-to-Know Regulations

Substances	CAS Number	MA Right-to-Know Law	NJ Right-to-Know Law	PA Right-to-Know Law
Crystalline silica, quartz	14808-60-7	Carcinogen Extraordinarily hazardous	1660	Present

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0*, Flammability 0, Physical Hazard 0 , PPE: At

Canadian Regulations

Canadian Domestic Substances List (DSL) All components listed on inventory or are exempt.

16. Other information

Preparation Information

Prepared By
Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

Revision Date: 14-Aug-2017

Reason for Revision SDS sections updated:
2
8
11

Additional information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms used in the safety data sheet
bw – body weight
CAS – Chemical Abstracts Service
d - day
EC50 – Effective Concentration 50%
ErC50 – Effective Concentration growth rate 50%
h - hour
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
NIOSH – National Institute for Occupational Safety and Health
NTP – National Toxicology Program
OEL – Occupational Exposure Limit
PEL – Permissible Exposure Limit
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
UN – United Nations
w/w - weight/weight

Key literature references and sources for data
www.ChemADVISOR.com/

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The

information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

AW Hydraulic Oil ISO 46 (Standard hydraulic Oil)

Section1. Chemical Product and Company Identification.
Product Name: **AW Hydraulic Oil ISO 46**
Code / Part Number:**9616, 9636, 9637, 9638,11360**
Distributor: SPX Hydraulic Technologies
5885 11th Street
Rockford, IL 61109
Phone: 815-874-5556
INFOTRAC 24 Hour Emergency Numbers:
800-535-5053 USA, Canada & Puerto Rico
352-323-3500 International
INFOTRAC emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

Material Use: The product designed for use in hydraulic applications.
Revision Date: 03/29/2012
Supercedes: 11/16/2011
Preparer: brauer, Denise
Section 2. Composition and Information on Ingredients.
Components: Petroleum Oil 95-99% CAS#64742-65-0
TLV=5mg/M^3
Additives 1-5% Proprietary
TLV not established
Exposure Limits:
TLV-TWA (8hr): 5mg/cubic m (oil mist)
STEL: 10 mg/ cubic m (oil mist)
Manufacturer Recommendation: Not applicable
Other Exposure Limits: Consult local, state, provincial or territorial authorities for acceptable exposure limits.

Section 3. Hazardous Identification.
Potential Health Effects: Not irritating to slight irritation to skin and eyes with no permanent damage. Relatively non-toxic via ingestion. This product has a low vapor pressure and is not expected to present an inhalation exposure at ambient conditions. At high temperatures or mechanical actions may produce vapors or mists, inhalation may cause irritation of the breathing passages. See section 11.
Section 4. First Aid Measures
Eye contact: Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Seek medical attention.
Skin Contact: Remove contaminated clothing – launder before reuse. Wash contaminated skin with running water and non-abrasive soap. Get medical attention if irritation develops or if product is injected under pressure into or under the skin.
Inhalation: Remove to fresh air. Get medical attention if breathing difficulty persists. If victim is not breathing, perform artificial respiration.
Ingestion: DO NOT induce vomiting. Seek medical attention.

Section 5. Fire-fighting Measures
Flammability: May be combustive at high temperature.
Flash point: >=200 deg C (392 deg F) (COC)
NFPA 704 Hazard Class
Health: 0 **Flammability:** 1 **Instability**: 0
(0-Minimal, 1-Slight, 2-Moderate, 3-Serious, 4-Severe)
Unusual Fire & Explosion Hazards: This material may burn, but will not ignite readily.
Extinguishing Media: Dry chemical, carbon dioxide, foam, or water spray is recommended. Water of foam may cause frothing of material heated above 212°F.Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces.

Fire Fighting Instructions: For fires beyond the initial stage, emergency responders in the immediate hazard area should wear protective clothing. When the potential chemical hazard is unknown, in enclosed or confined spaces, a self containing breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant. Isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done safely. Move undamaged containers from immediate hazard area if it can be done safely. Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done safely. Avoid spreading burning liquid with water used for cooling purposes.

Hazardous Combustion Products: Combustion may yield smoke, carbon monoxide, and other products of incomplete combustion. Oxides of sulfur, nitrogen or phosphorus may also be formed.

Section 6. Accidental Release Measures
Material Release or Spill: ELIMINATE ALL IGNITION SOURCES. Avoid contact. Stop leak if without risk. Contain spill. Absorb with inert absorbents. Place used absorbent in closed metal containers for later disposal or burn absorbent in suitable combustion chamber. Do not flush to sewers, steams or other bodies of water. Check with applicable jurisdiction for specific disposal requirements of spilled materials and empty containers. Notify the appropriate authorities immediately.
Section 7. Handling and Storage.
Handling: Avoid inhalation and skin contact especially when handling used oil. Keep away from sources of ignition. Do not reuse empty containers without commercial reconditioning. Practice good personal hygiene. Wash hands after handling oil and before eating. Launder work clothes frequently. Discard saturated leather goods.
Storage: Store in tightly closed containers in cool, dry, isolated, well-ventilated area, and away from incompatibles.

Section 8. Exposure Control / Personal Protection.
Engineering Controls: For normal application, special ventilation is not necessary. If user's operations generate vapors or mists, use ventilation to keep contaminants below exposure limits. Make-up air should always be supplied to balance air removed by exhaust. Have eyewash station and safety-shower close to workstation.
Personal Protection:
Eyes: Eye protection should be determined based on conditions of use. If product is used in application where splashing may occur, the use of safety goggles and/or a face shield should be considered.
Hands and Body: Wear appropriate chemically protective gloves and wear appropriate clothing to prevent skin contact.
Respiratory: NIOSH approved respirators should be used when airborne contamination is above exposure limits.
Feet: Wear appropriate footwear to prevent product from coming in contact with feet and skin.

Section 9. Physical and Chemical Properties.
Appearance, Physical State: Clear, Blue, Viscous Liquid
Odor: Mild petroleum
Viscosity: 41.4 – 50.6 cSt @ 40 deg C
Flash Point: >= 200 deg.C (392 deg. F)
Vapor Pressure: Negligible at ambient temperature and pressure.
Specific Gravity: 0.875 kg/L @20 deg. C (68 deg.F)
Water solubility: Insoluble in water
pH: Not applicable

Section 10. Stability and Reactivity

Stability: Stable under normal handling and storage condition
Hazardous Polymerization: Will not occur at normal working conditions.
Incompatible Substances / Conditions to Avoid: Reactive with oxidizing agents and acids.
Decomposition Products: Combustion can yield carbon, nitrogen, sulfur, phosphorus, and zinc oxides.

Section 11. Toxicological information

Routes of entry: Skin and eye contact, inhalation, ingestion.
Acute Lethality: Based on toxicity of components.
Acute oral toxicity (LD50): >5g/kg.
Chronic or Other Toxic Effects.
Dermal Route: Prolonged or repeated contact may cause skin irritation characterized by dermatitis or oil acne.
Acute Dermal LD50:>2g/kg.
Inhalation Route: Negligible breathing hazard at normal temperature. Elevated temperatures or mechanical action may form vapors, mists or fumes. Inhalation of oil mists or vapors from hot oil may cause irritation of the upper respiratory track.
Acute Inhalation LC50: No data
Eye Irritation / Inflammation: Repeated or prolonged contact may cause irritation but not permanent damage.
Immunotoxicity: Not available.
Skin Sensitization: Not expected to be skin sensitizer.
Respiratory Tract Sensitization: Not expected to be respiratory tract sensitizers.
Carcinogenicity: This product is not known to contain any chemicals at reportable quantities that are listed as carcinogens by NTP, IARC, OSHA.
Other Considerations: No additional remark.

Section 12. Ecological Information

Environmental Fate: Not available.
Persistence / Bioaccumulation Potential: Not available.
BOD5 and COD: Not available.
Product of Biodegradation: Not available.
Additional Remarks: No additional remarks.

Section 13. Disposal Considerations

Waste Disposal: Spent/used/waste oil may meet the requirements of a hazardous waste. Consult your local or regional authorities. Ensure that disposal or reprocessing is in compliance with government requirements and local disposal regulations.

Section14. Transport Information

TDG Classification: Not controlled under TDG (Canada).
DOT Shipping Description: Not classified as hazardous.
Special Provisions for Transport: Not applicable.

Section 15. Regulatory Information

This product is acceptable for use under the provisions of WHMIS-CPR. All components of this formulation are listed on the CEPA-DSL (Domestic Substances List).

All components of this formulation are listed on the US EPA-TSCA Inventory.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required By the CPR.

This product is not known to contain any chemicals at reportable quantities that are listed on the SARA 313 and 40 CFR 372.

This product is not controlled under the HCS.

HMIS (USA):	Health Hazard	1
	Fire Hazard	1
	Reactivity	0
	Personal Protection	B
NFPA (USA):	Health Hazard	0
	Fire Hazard	1
	Reactivity	0
	Specific Hazard	none

Rating: 0 Insignificant
1 Slight
2 Moderate
3 High
4 Extreme

Section 16. Other Information:

Prepared by Cutting and Grinding Fluids, Inc.
317 Peoples Ave.
Rockford, IL 61104, USA

Phone: 815-967-4400
Fax: 815-967-4404

Revision Date: 03/29/2012

The information presented herein has been complied from source considered to be dependable and accurate to the best of Cutting and Grinding Fluids, Inc. knowledge; however, Cutting and Grinding Fluids, Inc., makes no warranty whatsoever, expressed or implied, of Merchantability or Fitness for the Particular Purpose, regarding the accuracy of such data or the results to be obtained from the user thereof. Cutting and Grinding Fluids, Inc. assumes no responsibility for the injury to recipient or to the third persons or for any damage to any property and recipient assumes all such risks.

ELECTROLUBE
THE SOLUTIONS PEOPLE

SAFETY DATA SHEET
MULTI-PURPOSE GREASE

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identifier

Product name	MULTI-PURPOSE GREASE
Product No.	MPG, EMPG50T, ZE

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses	Grease
Uses advised against	At this moment in time we do not have information on use restrictions. They will be included in this safety data sheet when available

1.3. Details of the supplier of the safety data sheet

Supplier

ELECTROLUBE. A division of HK
WENTWORTH LTD
ASHBY PARK, COALFIELD WAY,
ASHBY DE LA ZOUCH, LEICESTERSHIRE
LE65 1JR
UNITED KINGDOM
+44 (0)1530 419600
+44 (0)1530 416640
info@hkw.co.uk

1.4. Emergency telephone number

+44 (0)1530 419600 between 8.30am - 5.00pm GMT Mon – Fri

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

Classification (EC 1272/2008)

Physical and Chemical Hazards	Not classified.
Human health	Not classified.
Environment	Not classified.

Classification (1999/45/EEC) Not classified.

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16.

Human health

Prolonged or repeated exposure may cause severe irritation.

2.2. Label elements

Label In Accordance With (EC) No. 1272/2008

No pictogram required.

2.3. Other hazards

Not Classified as PBT/vPvB by current EU criteria.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.2. Mixtures

Composition Comments

NON HAZARDOUS INGREDIENTS 100%

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

Inhalation

Not relevant

Ingestion

Rinse mouth thoroughly. Drink plenty of water. Get medical attention.

Skin contact

Wash the skin immediately with soap and water. Get medical attention if irritation persists after washing.

Eye contact

Make sure to remove any contact lenses from the eyes before rinsing. Promptly wash eyes with plenty of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

4.2. Most important symptoms and effects, both acute and delayed

Skin contact

Prolonged or repeated contact with skin may cause redness, itching, irritation and eczema/chapping.

4.3. Indication of any immediate medical attention and special treatment needed

Treat Symptomatically.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Extinguishing media

Extinguish with foam, carbon dioxide, dry powder or water fog.

5.2. Special hazards arising from the substance or mixture

Hazardous combustion products

Thermal decomposition or combustion may liberate carbon oxides and other toxic gases or vapours.

Unusual Fire & Explosion Hazards

No unusual fire or explosion hazards noted.

Specific hazards

The product is non-combustible. If heated, harmful vapours may be formed.

5.3. Advice for firefighters

Special Fire Fighting Procedures

Use water to keep fire exposed containers cool and disperse vapours. Water spray may be used to flush spills away from exposures and dilute spills to non-flammable mixtures.

Protective equipment for fire-fighters

Self contained breathing apparatus and full protective clothing must be worn in case of fire.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Wear protective clothing as described in Section 8 of this safety data sheet.

6.2. Environmental precautions

Avoid discharge into drains, water courses or onto the ground.

6.3. Methods and material for containment and cleaning up

Absorb in vermiculite, dry sand or earth and place into containers. Flush with plenty of water to clean spillage area.

6.4. Reference to other sections

Wear protective clothing as described in Section 8 of this safety data sheet. See section 11 for additional information on health hazards. For waste disposal, see section 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Avoid spilling, skin and eye contact. Get medical attention if any discomfort continues.

7.2. Conditions for safe storage, including any incompatibilities

Store in tightly closed original container in a dry, cool and well-ventilated place. Keep in original container.

Storage Class

Unspecified storage.

7.3. Specific end use(s)

The identified uses for this product are detailed in Section 1.2.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Ingredient Comments

WEL = Workplace Exposure Limits

8.2. Exposure controls

Process conditions

Use engineering controls to reduce air contamination to permissible exposure level. Provide eyewash station.

Engineering measures

All handling to take place in well-ventilated area.

Hand protection

Use suitable protective gloves if risk of skin contact. The most suitable glove must be chosen in consultation with the gloves supplier, who can inform about the breakthrough time of the glove material. Gloves should conform to EN374

Eye protection

If risk of splashing, wear safety goggles or face shield. EN166

Other Protection

Wear appropriate clothing to prevent any possibility of skin contact.

Hygiene measures

DO NOT SMOKE IN WORK AREA! Wash hands at the end of each work shift and before eating, smoking and using the toilet. Wash promptly if skin becomes wet or contaminated. Use appropriate skin cream to prevent drying of skin. When using do not eat, drink or smoke.

Environmental Exposure Controls

Keep container tightly sealed when not in use.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance	Grease
Colour	Beige.
Odour	Mild.
Solubility	Insoluble in water
Initial boiling point and boiling range (°C)	>316 (600 F)
Relative density	0.910
Vapour pressure	<0.1 mm Hg 20 (68 F)
Viscosity	@ °c
Flash point (°C)	230 (446 F) CC (Closed cup).
Auto Ignition Temperature (°C)	> 300 (572 F)
Flammability Limit - Lower(%)	0.9
Flammability Limit - Upper(%)	7.0
Partition Coefficient (N-Octanol/Water)	>3.5

9.2. Other information

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

There are no known reactivity hazards associated with this product.

10.2. Chemical stability

Stable under normal temperature conditions.

10.3. Possibility of hazardous reactions

Not known.

Hazardous Polymerisation

Will not polymerise.

10.4. Conditions to avoid

Avoid excessive heat for prolonged periods of time.

10.5. Incompatible materials

Materials To Avoid

No specific, or groups of materials are likely to react to produce a hazardous situation.

10.6. Hazardous decomposition products

Fire creates: Carbon monoxide (CO). Carbon dioxide (CO_2).

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Toxicological information

No information available.

Other Health Effects

This substance has no evidence of carcinogenic properties.

Ingestion

Liquid irritates mucous membranes and may cause abdominal pain if swallowed. Nausea, vomiting.

Health Warnings

No specific health warnings noted. No specific acute or chronic health impact noted, but this chemical may still have adverse impact on human health, either in general or on certain individuals with pre-existing or latent health problems.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity

Not regarded as dangerous for the environment.

12.1. Toxicity

12.2. Persistence and degradability

Degradability

There are no data on the degradability of this product.

12.3. Bioaccumulative potential

Bioaccumulative potential

No data available on bioaccumulation.

Partition coefficient >3.5

12.4. Mobility in soil

Mobility:

The product contains substances, which are insoluble in water and which may spread on water surfaces.

12.5. Results of PBT and vPvB assessment

This product does not contain any PBT or vPvB substances.

12.6. Other adverse effects

Not available.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Dispose of waste and residues in accordance with local authority requirements.

SECTION 14: TRANSPORT INFORMATION

General	The product is not covered by international regulation on the transport of dangerous goods (IMDG, IATA, ADR/RID).
Road Transport Notes	Not Classified
Rail Transport Notes	Not classified.
Sea Transport Notes	Not classified.
Air Transport Notes	Not classified.

14.1. UN number

14.2. UN proper shipping name

14.3. Transport hazard class(es)

Transport Labels

No transport warning sign required.

14.4. Packing group

14.5. Environmental hazards

Environmentally Hazardous Substance/Marine Pollutant

No.

14.6. Special precautions for user

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code

No information required.

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Statutory Instruments

The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009 (S.I 2009 No. 716). Control of Substances Hazardous to Health.

Guidance Notes

Workplace Exposure Limits EH40.

EU Legislation

Commission Directive 2000/39/EC of 8 June 2000 establishing a first list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, including amendments.

Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 with amendments.

Authorisations (Title VII Regulation 1907/2006)

No specific authorisations are noted for this product.

Restrictions (Title VIII Regulation 1907/2006)

No specific restrictions of use are noted for this product.

15.2. Chemical Safety Assessment

Material Safety Data Sheet
For
PORTLAND CEMENT

Section 1 - IDENTIFICATION

Product Names: Nevada Portland Cement - Type I/II

MSDS Information
This MSDS was revised January 5, 2010 and supercedes and replaces any prior versions.

Product Code
Standard Industrial Classification: 3241

Chemical Family
Calcium compounds. Calcium silicate compounds and other calcium compounds containing iron and aluminum make up the majority of this product. Major compounds:

$3CaO \cong SiO_2$	Tricalcium silicate	CAS#12168-85-3
$2CaO \cong SiO_2$	Dicalcium silicate	CAS#10034-77-2
$3CaOAl_2O_3$	Tricalcium aluminate	CAS#12042-78-3
$4CaO \cong Al_2O_3 \cong Fe_2O_3$	Tetracalcium aluminoferrite	CAS#12068-35-8
$CaSO_4 \cong 2H_2O$	Calcium sulfate dihydrate or Gypsum	CAS#7778-18-9

Chemical Name and Synonyms
Portland cement. Also known as hydraulic cement.

Formula
This product consists of finely ground portland cement clinker mixed with a small amount of calcium sulfate.*

Supplier/Manufacturer

Nevada Cement Company
I-80 East @ Exit 46
Fernley, Nevada 89408
(775) 575-2281

Emergency Contact Information

Safety Director - (775) 575-2281, Ext 288
Chief Chemist - (775) 575-2281, Ext. 252

*Trace Elements
Portland cement is made from materials mined from the earth and is processed using energy provided by fuels; and therefore may contain trace amounts of naturally occurring materials which might be detected during chemical analysis. For example: Portland cement may contain up to 0.75% insoluble residue, of which <0.1% may be free crystalline silica. Other trace constituents may include potassium and sodium sulfate compounds, chromium compounds, and nickel compounds.

Section 2 - COMPONENTS

Hazardous Substances	OSHA PEL (8-Hour TWA)	ACGIH TLV-TWA (1995 - 1996)	NIOSH REL (8-Hour TWA)
Portland Cement Clinker (CAS#65997-15-1) Nominal 95% by weight	50 million particles/ft^3	10mg total dust/m^3	
Calcium sulfate (CAS#7778-18-9) [Gypsum (CAS#13397-24-5)] Nominal 5% by weight	5mg respirable dust/m^3 10mg total dust/m^3	10mg total dust/m^3	
Calcium Oxide (CAS#1306-78-8) (Free Lime) < 4% by weight	5mg/m^3	2mg/m^3	
Magnesium Oxide (CAS #1309-48-4) < 5% by weight	15mg total dust/m^3	10mg total dust/m^3	

Crystalline silica (CAS#14808-60-7	10mg of respirable dust/m^3 (%SiO2 +2)	0.10mg respirable quartz/m^3	0.05mg respirable quartz/m^3

Section 3 - HAZARDS IDENTIFICATION/TOXICOLOGICAL INFORMATION

Emergency Overview:
Portland cement is a light gray powder that poses little immediate hazard. A single short-term exposure to the dry powder is not likely to cause serious harm. However, exposure of sufficient duration to wet portland cement can cause serious, potentially irreversible tissue (including skin or eye) destruction in the form of chemical (caustic) burns, including third degree burns. The same type of tissue destruction can occur if wet or moist areas of the body are exposed for sufficient duration to dry portland cement.

Potential Health Effects:
Potential effects resulting from **eye contact**;
Exposure to airborne dust may cause immediate or delayed irritation or inflammation.
Eye contact by larger amounts of dry powder or splashes of wet portland cement may cause effects ranging from moderate eye irritation to chemical burns and blindness. Such exposures require immediate first aid (see Section 4) and medical attention to prevent significant damage to the eye.

Potential effects resulting from **skin contact:**
Discomfort or pain cannot be relied upon to alert a person to a hazardous skin exposure. Consequently, the only effective means of avoiding skin injury or illness involves minimizing or avoiding skin contact, particularly contact with wet cement. Persons exposed to wet cement may not feel discomfort until hours after the exposure has ended and significant injury has occurred.

Exposure to dry portland cement may cause drying of the skin with consequent mild irritation or more significant effects attributable to aggravation of other conditions. Dry portland cement contacting wet skin or exposure to moist or wet portland cement may cause more severe skin effects including thickening, cracking or fissuring of the skin. Prolonged exposure can cause severe skin damage in the form of (caustic) chemical burns.

Some individuals may exhibit an allergic response upon exposure to portland cement, possibly due to trace amounts of chromium. The response may appear in a variety of forms ranging from a mild rash to severe skin ulcers. Persons already sensitized may react to their first contact with the product. Other persons may first experience this effect after years of contact with hydraulic cement products.

Potential effects resulting from **inhalation:**
Portland cement may contain trace amounts (<0.1%) of free crystalline silica. Prolonged exposure to respirable free crystalline silica may aggravate other lung conditions. It also may cause delayed lung injury including silicosis, a disabling and potentially fatal lung disease.

Exposure to portland cement may cause irritation to the moist mucous membranes of the nose, throat, and upper respiratory system. It may also leave unpleasant deposits in the nose.

Potential effects resulting from **ingestion:**
Although small quantities of dust are not known to be harmful, ill effects are possible if larger quantities are consumed. Portland cement should not be eaten under any circumstances.

Carcinogenic Potential:
Portland cement is not listed as a carcinogen by IARC, the State of California, NTP or OSHA. It does, however, contain trace amounts (<0.1%) of a substance listed as a carcinogen by some of these organizations. Crystalline silica is now classified by IARC as a known human carcinogen (Group 1). It is known by the State of California to cause cancer. NTP has characterized respirable crystalline silica as "reasonably anticipated to be (a) carcinogen".

Medical Conditions Which May Be Aggravated By Inhalation or Dermal Exposure:
- Pre-existing upper respiratory and lung diseases.
- Unusual (hyper) sensitivity to hexavalent chromium (chromium +6) salts.

Section 4 - FIRST AID

Eyes
Immediately flush eyes thoroughly with water. Continue flushing eyes for at least 15 minutes, including under lids, to remove all particles. Call physician immediately.

Skin
Wash skin with cool water and pH-neutral soap or a mild detergent intended for use on skin. Seek medical treatment in all cases of prolonged exposure to wet cement, cement mixtures, liquids from fresh cement products, or prolonged wet skin exposures to dry cement.

Inhalation of Airborne Dust
Remove to fresh air. Seek medical help if coughing and other symptoms do not subside. (Inhalation of gross amounts of portland cement requires immediate medical attention.)

Ingestion
Do not induce vomiting. If conscious, have the victim drink plenty of water and call a physician immediately.

Section 5 - FIRE & EXPLOSION DATA

Flash Point	None
Lower Explosive Limit	None
Upper Explosive Limit	None
Auto Ignition Temperature	Not combustible
Extinguishing Media	Not combustible
Special Fire Fighting Procedures	None (Although portland cement poses no fire-related hazards, a self-contained breathing apparatus is recommended to limit exposure to combustion products when fighting any fire.)
Hazardous Combustion Products	None
Unusual Fire and Explosion Hazards	None

Section 6 - ACCIDENTAL RELEASE MEASURES

Collect dry material using a scoop. Avoid actions that cause dust to become airborne. Avoid inhalation of dust and contact with skin. Wear appropriate personal protective equipment as described in Section 8.

Scrape up wet material and place in an appropriate container. Allow the material to "dry" before disposal. Do not attempt to wash portland cement down drains.

Dispose of waste material according to local, state and federal regulations.

Section 7 - HANDLING AND STORAGE

Keep portland cement dry until used. Normal temperature and pressure do not affect the materials.

Promptly remove dusty clothing or clothing which is wet with cement fluids and launder before reuse. Wash thoroughly after exposure to dust or wet cement mixture or fluids.

Section 8 - EXPOSURE CONTROL/PERSONAL PROTECTION

Skin Protection
Prevention is essential to avoiding potentially severe skin injury. Avoid contact with unhardened (wet) portland cement products. If contact occurs, promptly wash affected area with soap and water. Where prolonged exposure to unhardened portland cement products might occur, wear impervious clothing and gloves and boots to eliminate skin contact.

Respiratory Protection
Avoid actions that cause dust to become airborne. Use local or general ventilation to control exposures below applicable exposure limits. Use NIOSH/MSHA-approved respirators in poorly ventilated areas when dust causes discomfort or irritation, or where there is an applicable exposure limit (Advisory: Respirators and filters purchased after July 10, 1998 must be certified under 42 CFR 84).

Ventilation
Use local exhaust or general dilution ventilation to control exposure below applicable limits.

Eye Protection
When engaged in activities where cement dust or wet cement or concrete could contact the eye, wear safety glasses with side shields or goggles. In extremely dusty environments and unpredictable environments, wear unvented or indirectly vented goggles to avoid eye irritation or injury. Contact lenses should not be worn when working with portland cement or fresh cement products.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Gray or White powder
Odor	No distinct odor
Physical state	Solid (powder)
pH (in water)(ASTM D 1293-95)	12 to 13
Solubility in water	Slightly soluble (0.1 to 1.0%)
Vapor pressure	Not applicable
Vapor density	Not applicable
Boiling point	Not applicable (i.e. > 1000°C)
Melting point	Not applicable
Specific gravity (H20 = 1.0)	3.15
Evaporation rate	Not applicable

Section 10 - STABILITY AND REACTIVITY

Stability
Stable

Conditions To Avoid
Unintentional contact with water.

Incompatibility
Wet portland cement is alkaline. As such it is incompatible with acids, ammonium salts and aluminum metal.

Hazardous Decomposition
Will not spontaneously occur. Adding water results in hydration and produces (caustic) calcium hydroxide.

Hazardous Polymerization
Will not occur.

Section 11 - TOXICOLOGICAL INFORMATION - See Section 3

Section 12 - ECOLOGICAL INFORMATION

Ecotoxicity
No recognized unusual toxicity to plants or animals.

Relevant Physical and Chemical Properties
(See Sections 9 and 10).

Section 13 - DISPOSAL

Dispose of waste material, including bags, according to local, state, and federal regulations.

Section 14 - TRANSPORTATION DATA

Hazardous Materials Description/Proper Shipping Name
Portland cement is not hazardous under U.S. Department of Transportation (DOT) regulations.

Section 15 - OTHER REGULATORY INFORMATION

Status Under USDOL-OSHA Hazard Communication Rule 29 CFR 1910.1200
Portland cement is considered a "hazardous chemical" under this regulation, and should be part of any hazard communication program.

Status Under CERCLA/Superfund 40 CFR 117 and 302(v)
Not listed.

Hazard Category Under SARA (Title III) Section 311 and 312
Portland cement qualifies as a "hazardous substance" with delayed health effects.

Status Under SARA (Title III) Section 313
Not subject to reporting requirements under Section 313.

Status Under TSCA (as of May 1997)
Some substances in portland cement are on the TSCA inventory list.

Status Under the Federal Hazardous Substances Act
Portland cement is a "hazardous substance" subject to statutes promulgated under the subject act.

Status Under California Proposition 65
Crystalline silica is known by the State of California to cause cancer.

Status Under WHMIS
Portland cement is considered to be a hazardous material under the Hazardous Products Act as defined by the Controlled Products regulations (class E - corrosive material) and is therefore subject to the labeling and MSDS requirements of the workplace hazardous materials information system (WHMIS).

Section 16 - OTHER INFORMATION

Prepared By
Nevada Cement Company
I-80 East @ Exit 46
Fernley, Nevada 89408

Revision Date
January 5, 2004

Other Important Information
Portland cement should only be used by knowledgeable persons. Inexperienced product users must obtain proper training before using this product. A key to using the product safely requires the user to recognize that portland cement chemically reacts with water, and that some of the

intermediate products of this reaction (that is, those present while a portland cement product is "setting") pose a far more severe hazard than does portland cement itself.

While the information provided in this material safety data sheet is believed to provide a useful summary of the hazards of portland cement as it is commonly used, the sheet cannot, and does not, anticipate and provide all of the information that might be needed in every situation. In particular, the data furnished in this sheet does not address hazards that may be posed by other materials mixed with portland cement products. Users therefore, should review other applicable material safety data sheets before working with this portland cement or working on portland cement products, for example, portland cement concrete.

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HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **QUIK-GEL®**

Revision Date: 14-Aug-2017 **Revision Number:** 20

1. Identification

1.1. Product Identifier

Product Trade Name:	QUIK-GEL®
Synonyms	None
Chemical Family	Mineral
Internal ID Code	HM003747

1.2 Recommended use and restrictions on use

Application	Viscosifier
Uses advised against	No information available

1.3 Manufacturer's Name and Contact Details

Halliburton Energy Services, Inc.
645 - 7th Ave SW Suite 1800
Calgary, AB
T2P 4G8
Canada
Telephone: 1-403-231-9300

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000

Prepared By Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

1.4. Emergency telephone number

Emergency Telephone Number 1-866-519-4752 or 1-760-476-3962
Global Incident Response Access Code: 334305
Contract Number: 14012

2. Hazard Identification

2.1 Classification of the substance or mixture

Carcinogenicity	Category 1A - H350
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1 - H372

2.2. Label Elements

Hazard Pictograms

Signal Word: Danger

Hazard Statements
H350 - May cause cancer by inhalation
H372 - Causes damage to organs through prolonged or repeated exposure if inhaled

Precautionary Statements

Prevention
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe dust/fume/gas/mist/vapors/spray
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P280 - Wear protective gloves/protective clothing/eye protection/face protection

Response
P308 + P313 - IF exposed or concerned: Get medical advice/attention
P314 - Get medical attention/advice if you feel unwell

Storage
P405 - Store locked up

Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations

2.3 Other hazards which do not result in classification

This product contains Wyoming bentonite or other sorptive clays. Crystalline silica forms found in this particular clay are limited to quartz. Extreme temperatures that can generate cristobalite or tridymite are not expected to occur under realistic conditions. In addition, all quartz found in sorptive clays are considered "occluded", i.e., strongly coated with an amorphous silica surface. Occluded quartz has been experimentally-determined to be relatively non-toxic compared to unoccluded quartz. A lack of health effects found in several studies examining occupational exposure to sorptive clays also suggest that chronic inhalation of sorptive clays is not expected to result in silicosis or cancer. In light of these findings OSHA has recently exempted Wyoming bentonite and other sorptive clays from the crystalline silica PEL in §1910.1053(a)(1)(iii).

3. Composition/information on Ingredients

Substances	CAS Number	PERCENT (w/w)	GHS Classification - Canada	HMIRA Registry Number	Filing Date	Decision Granted Date
Crystalline silica, quartz	14808-60-7	1 - 5%	Carc. 1A (H350) STOT RE 1 (H372)	Not applicable	Not applicable	Not applicable

The exact percentage (concentration) of the composition has been withheld as proprietary.

4. First aid measures

4.1. Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Rinse mouth with water many times.

4.2 Most important symptoms/effects, acute and delayed

Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically.

5. Fire-fighting measures

5.1. Extinguishing media

Suitable Extinguishing Media

All standard fire fighting media

Extinguishing media which must not be used for safety reasons

None known.

5.2 Specific hazards arising from the substance or mixture

Special exposure hazards in a fire

None anticipated

5.3 Special protective equipment and precautions for fire-fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing.

See Section 8 for additional information

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. Handling and Storage

7.1. Precautions for safe handling

Handling Precautions

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet. Use appropriate protective equipment.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Information

Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Keep from excessive heat. Do not reuse empty container. Product has a shelf life of 36 months.

8. Exposure Controls/Personal Protection

8.1 Occupational Exposure Limits

Substances	CAS Number	OSHA PEL-TWA	ACGIH TLV-TWA

Crystalline silica, quartz	14808-60-7	TWA: 50 µg/m³	TWA: 0.025 mg/m³

8.2 Appropriate engineering controls

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits.

8.3 Individual protection measures, such as personal protective equipment

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (N95, P2/P3)

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State: Powder
Odor: Mild earthy
Color Various
Odor Threshold: No information available

Property Remarks/ - Method	Values
pH:	8-10
Freezing Point / Range	No data available
Melting Point / Range	No data available
Boiling Point / Range	No data available
Flash Point	No data available
Flammability (solid, gas)	No data available
Upper flammability limit	No data available
Lower flammability limit	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	2.6
Water Solubility	Partly soluble
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%) No data available

10. Stability and Reactivity

10.1. Reactivity

Not expected to be reactive.

10.2. Chemical stability
Stable

10.3. Possibility of hazardous reactions
Will Not Occur

10.4. Conditions to avoid
None anticipated

10.5. Incompatible materials
Hydrofluoric acid.

10.6. Hazardous decomposition products
Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. Toxicological Information

11.1 Information on likely routes of exposure
Principle Route of Exposure Eye or skin contact, inhalation.

11.2 Symptoms related to the physical, chemical and toxicological characteristics
Acute Toxicity

Inhalation Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause mechanical irritation to eye.
Skin Contact None known.
Ingestion None known.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with

an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

This product contains Wyoming bentonite or other sorptive clays. Crystalline silica forms found in this particular clay are limited to quartz. Extreme temperatures that can generate cristobalite or tridymite are not expected to occur under realistic conditions. In addition, all quartz found in sorptive clays are considered "occluded", i.e., strongly coated with an amorphous silica surface (Wendlandt et al., 2007; Hochella and Muryama, 2010; SMI, 2014). Occluded quartz has been experimentally-determined to be relatively non-toxic compared to unoccluded quartz (Geh et al., 2006; Creutzenberg et al., 2008). A lack of health effects found in several studies examining occupational exposure to sorptive clays also suggest that chronic inhalation of sorptive clays is not expected to result in silicosis or cancer (Waxweiler et al., 1988; ACGIH, 1991; USEPA, 1996; IARC, 2005). In light of these findings OSHA has recently exempted Wyoming bentonite and other sorptive clays from the crystalline silica PEL in §1910.1053(a)(1)(iii).

11.3 Toxicity data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Crystalline silica, quartz	14808-60-7	> 15000 mg/kg (human)	No data available	No data available

Substances	CAS Number	Skin corrosion/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the skin

Substances	CAS Number	Serious eye damage/irritation
Crystalline silica, quartz	14808-60-7	Non-irritating to the eye

Substances	CAS Number	Skin Sensitization
Crystalline silica, quartz	14808-60-7	No information available.

Substances	CAS Number	Respiratory Sensitization
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	Mutagenic Effects
Crystalline silica, quartz	14808-60-7	Not regarded as mutagenic.

Substances	CAS Number	Carcinogenic Effects
Crystalline silica, quartz	14808-60-7	Contains crystalline silica which may cause silicosis, a delayed and progressive lung disease. The IARC and NTP have determined there is sufficient evidence in humans of the carcinogenicity of crystalline silica with repeated respiratory exposure.

Substances	CAS Number	Reproductive toxicity
Crystalline silica, quartz	14808-60-7	No information available

Substances	CAS Number	STOT - single exposure
Crystalline silica, quartz	14808-60-7	No significant toxicity observed in animal studies at concentration requiring classification.

Substances	CAS Number	STOT - repeated exposure
Crystalline silica, quartz	14808-60-7	Causes damage to organs through prolonged or repeated exposure if inhaled: (Lungs)

Substances	CAS Number	Aspiration hazard
Crystalline silica, quartz	14808-60-7	Not applicable

12. Ecological Information

12.1. Toxicity

Product Ecotoxicity Data

No data available

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Crystalline silica, quartz	14808-60-7	EC50 (72 h) =440 mg/L (Selenastrum capricornutum)(similar substance)	LL0 (96 h) =10000 mg/L (Danio rerio)(similar substance)	No information available	LL50 (24 h) >10000 mg/L (Daphnia magna)(similar substance)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Crystalline silica, quartz	14808-60-7	The methods for determining biodegradability are not applicable to inorganic substances.

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Crystalline silica, quartz	14808-60-7	No information available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Crystalline silica, quartz	14808-60-7	No information available

12.5 Other adverse effects

No information available

13. Disposal Considerations

13.1. Waste treatment methods

Disposal methods If practical, recover and reclaim, recycle, or reuse by the guidelines of an approved local reuse program. Should contaminated product become a waste, dispose of in a licensed industrial landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. Transport Information

Canadian TDG

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

US DOT

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IMDG/IMO

UN Number Not restricted
UN proper shipping name: Not restricted

Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

IATA/ICAO

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable
Environmental Hazards: Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable
Special Precautions for User None

15. Regulatory Information

Canadian Regulations

Canadian Domestic Substances List (DSL) All components listed on inventory or are exempt.

US Regulations

US TSCA Inventory All components listed on inventory or are exempt.

TSCA Significant New Use Rules - S5A2

Substances	CAS Number	TSCA Significant New Use Rules - S5A2
Crystalline silica, quartz	14808-60-7	Not applicable

EPA SARA Title III Extremely Hazardous Substances

Substances	CAS Number	EPA SARA Title III Extremely Hazardous Substances
Crystalline silica, quartz	14808-60-7	Not applicable

EPA SARA (311,312) Hazard Class

Specific target organ toxicity (single or repeated exposure)
Carcinogenicity

EPA SARA (313) Chemicals

Substances	CAS Number	Toxic Release Inventory (TRI) - Group I	Toxic Release Inventory (TRI) - Group II
Crystalline silica, quartz	14808-60-7	Not applicable	Not applicable

EPA CERCLA/Superfund Reportable Spill Quantity

Substances	CAS Number	CERCLA RQ
Crystalline silica, quartz	14808-60-7	Not applicable

EPA RCRA Hazardous Waste Classification

If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0*, Flammability 0, Physical Hazard 0 , PPE: E

16. Other information

Preparation Information

Prepared By Chemical Stewardship
Telephone: 1-281-871-6107
e-mail: fdunexchem@halliburton.com

Revision Date:	14-Aug-2017
Reason for Revision	SDS sections updated: 2 8 11

Additional information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms used in the safety data sheet
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
ErC50 – Effective Concentration growth rate 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
mg/kg – milligram/kilogram
mg/L – milligram/liter
NIOSH – National Institute for Occupational Safety and Health
NTP – National Toxicology Program
OEL – Occupational Exposure Limit
PEL – Permissible Exposure Limit
ppm – parts per million
STEL – Short Term Exposure Limit
TWA – Time-Weighted Average
UN – United Nations
h - hour
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/

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End of Safety Data Sheet

Safety Data Sheet

GHS – United States

Section 1. Product and Company Identification

Product Names Standard Sand & Silica, Co. Sand

Synonym Silica Sand, Quartz Sand

Supplier/ Manufacturer

Standard Sand & Silica, Co.
1850 Hwy. 17-92 N.
Davenport, FL 33837
863-422-7100 phone
863-421-7349 fax

Emergency Phone Number 863-557-9411

Product Use Industrial , Construction and Agriculture

Restrictions on use Not applicable

Section 2. Hazards Identification

OSHA/HCS status This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)

Classification of the substance or mixture **OSHA - CARCINOGENICITY** (Inhalation) - Category 1A
(See section 16 for OSHA, IARC, and NTP carcinogen listings)
OSHA - SPECIFIC TARGET ORGAN TOXICITY (Repeated Exposure) (respiratory tract) (inhalation) - Category 1

Signal Word **Danger**

Hazard Statement Standard Sand is a naturally occurring mineral and contains crystalline silica levels of 98-100%.

• **CARCINOGENICITY:** This product contains crystalline silica. Repeated, prolonged inhalation of dust may cause delayed lung injury which may result in silicosis or pneumoconiosis. The International Agency For Research On Cancer in its publication, "IARC Monographs On the Evaluation Of The Carcinogenic Risk To Humans – Silica, Some Silicates, Coal Dust and Para-aramid Fibrils" - Volume 68, 1997, has concluded that there is sufficient evidence of the carcinogenicity of crystalline silica in humans, and has, therefore, classified crystalline silica in, Group 1, Carcinogenic to Humans. The National Toxicology Program's ("NTP's") Ninth Annual Report on Carcinogens 2000, lists crystalline silica (respirable) as a substance which is known to be a human carcinogen. In humans, a number of studies have found an association between lung cancer and exposure to dust containing respirable crystalline silica. In many of these studies, though not all, lung cancer risks were elevated and could not be explained by confounding factors such as cigarette smoking or arsenic or random inhalation. While the IARC working group concluded there was sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or crystobalite, it noted that carcinogenicity in humans was not detected in all circumstances studied.

ACGIH states that it is a suspected cause of cancer. Other forms of respirable crystalline silica (e.g. tridymite and cristobalite) may also be present or formed under certain industrial processes.

GHS label elements / Hazard pictograms

Health Hazard
(carcinogen)

Irritant
(skin,eye & respiratory tract)

Precautionary Statements

Avoid generating dust. Do not breathe dust. Do not eat drink or smoke when using this product. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection/ face protection. In case of inadequate ventilation, wear respiratory protection. If exposed or concerned, get medical advice/attention.

Storage Warning

Restrict of control access to stockpile areas. Engulfment hazard: To prevent burial or suffocation, do not Enter a confined space, such as a silo, bulk truck, or other storage container or vessel that stores or Contains sand with an effective procedure for assuring safety.

Unclassified Hazards

None Known

% of ingredients with unknown acute toxicity

None Known

Section 3. Composition / Information on Ingredients

Substances:

Chemical	Formula	CAS & ICSC Numbers		Percentage	
Quartz (Crystalline Silica)	SiO^2	CAS # 14808-60-7	ICSC # 0808	99.0-100.0%	

Section 4. First-Aid Measures

Description of first-aid Measures:	
First-aid measures general	Never give anything by mouth to an unconscious person. If you feel unwell, seek medical attention.
First-aid measures after inhalation	Inhaling dust may cause discomfort in the chest, shortness of breath and coughing. Prolonged inhalation may cause chronic health effects. Prolonged or repeated inhalation of respirable crystalline silica liberated from this product can cause silicosis and may cause cancer. In cases of gross inhalation remove victim to fresh air. If breathing has stopped, perform artificial respiration. If breathing is difficult, have qualified personnel administer oxygen. Get prompt medical attention.
First-aid measures after skin contact	Remove contaminated clothing. Wash affected area with soap and warm water. Obtain medical attention if irritation persists.
First-aid measures after eye contact	Flush the eyes immediately with large amounts of running water, lifting the upper and lower lids occasionally. Remove contact lenses if present and easy to do. If irritation persists or for imbedded foreign body, get immediate medical attention.
First-aid measures after ingestion	Rinse mouth. Do NOT induce vomiting. Unlikely to be toxic by ingestion. If discomfort persists, seek medical attention.

Most Important Symptoms and Effects, Both Acute and Delayed:	
Symptoms/injuries	Causes damage to organs through prolonged or repeated exposure (inhalation).
Symptoms/injuries after inhalation	May cause cancer by inhalation. Dust from this product may cause irritation to the respiratory tract.
Symptoms/injuries after skin contact	Prolonged contact with large amounts of dust may cause mechanical irritation.
Symptoms/injuries after eye contact	Prolonged contact with large amounts of dust may cause mechanical irritation.
Symptoms/injuries after ingestion	If a large quantity has been ingested: intestinal blockage. Gastrointestinal irritation.
Chronic symptoms	Repeated or prolonged exposure to respirable crystalline silica dust will cause lung damage in the form of silicosis. Symptoms will include progressively more difficult breathing, cough, fever, and weight loss. Acute silicosis can be fatal.

If exposed or concerned, get medical advice and attention.

Section 5. Fire-Fighting Measures

National Fire Protection Association (U.S.A.)

Suitable extinguishing media	**This product is not flammable or combustible and is compatible with all extinguishing media.** **Use extinguishing media appropriate for surrounding fire.**
Unsuitable extinguishing media	No restrictions on extinguishing media for this material.
Special hazards arising from the substance or mixture	This material is not flammable and does not support fire. The paper bags and bulk bags containing the material are flammable. This product is not a combustible dust Dry powders may accumulate static charge in handling, which can be a source of ignition for flammable atmospheres.
Hazardous thermal decomposition products	This material does not contain hazardous decomposition products.
Special protective actions for fire-fighters	No special actions are necessary.
General fire hazards	No unusual fire or explosion hazards noted.
Specific Methods	Contact with powerful oxidizing agents may cause fire and/or explosions,

Section 6. Accidental Release Measures

Use of personal precautions

Avoid inhalation of dry silica dust.
Wear appropriate protective equipment when cleaning up dry silica sand dust.

Emergency procedures

There are no emergency procedures required for this material.

Methods and Materials For containment

Silica sand waste is not reactive, flammable or biodegradable. Use conventional means; e.g. sweeping, vacuum, etc.

Clean up procedures

Spilled material, where dust is generated, may overexpose Cleanup personnel to respirable crystalline silica- containing dust. Provide appropriate exhaust ventilation at places where dust is formed. Do not breath dust. Avoid prolonged exposure.
If uncontaminated, collect using dustless method (HEPA vacuum or wet method)and place in appropriate container for use. Wear appropriate respiratory protection to protect against respirable

crystalline silica dust. If contaminated, use appropriate method for the nature of contamination, and consider possible toxic or fire hazards associated with the contaminating substances. Collect for appropriate disposal.

Environmental Precautions

Avoid discharge of fine particulate matter into drains or water Courses.

Section 7. Handling & Storage

Precautions for safe handling

Do not handle until all safety precautions have been read and understood. Keep formation of airborne dusts to a minimum. Do not rely on your sight to determine if dust is in the air. Use normal precautions against bag breakage or spills of bulk material. Use good housekeeping in storage and use areas to prevent accumulation of dust in work area. Provide adequate exhaust ventilation at places where dust is formed. Do not breathe dust. Avoid prolonged exposure. Wear appropriate personal protective equipment and observe good industrial hygiene practices.

To reduce the risk of developing silicosis, lung cancer and other adverse health effects, the ACGIH recommends use of every means available to keep exposures below the recommended TLV. Refer to the most recent government and local regulations when selecting a respirator. Maintain, clean and fit test respirators in accordance with applicable regulations. Maintain and test ventilation and dust collection equipment. Launder clothing that has become dusty. Empty bags and containers retain silica residue and must be Handled in accordance with the provisions of this Safety Data Sheet. Warn and train employees in accordance with local, state and Federal regulations.

Dust can accumulate electrostatic charges due to friction from transfer and mixing operations and cause an electric spark (ignition source) which can ignite flammable liquids and atmospheres. Provide adequate precautions when adding this

product to flammable and combustible mixtures like paints and coatings, such as electrical grounding and bonding, inert atmospheres or non- sparking tools. See also ASTM Standard Practice E1132-99a, "Standard Practice for Health Requirements Relating to Occupational Exposure to Respirable Crystalline Silica. Paper bags weigh 50 lbs. Use proper lifting techniques to avoid physical injury. Bulk bags weigh 2000 lbs. Use proper equipment to lift.

Recommendations on the Conditions for safe storage

No special storage considerations, but keep in a dry location. Avoid Dust formation or accumulation.

Section 8. Exposure Controls / Personal Protection

Chemical Name	CAS Numbers	Occupational Exposure Limits
Quartz,(Crystalline Silica) SiO^2	CAS#14808-60-7	ACGIH TLV: TWA 0.025 mg/ m^3 (respirable) OSHA PEL: .05 mg/m^3, calculated as an 8-hr TWA (respirable) CAL OSHA PEL: .05 mg/ m3, calculated an 8-hr TWA (respirable) NIOSH REL: 0.05 mg/m3 as determined by a full shift sample up to 10-hour working day, 40 hours per week.

Appropriate engineering Controls

Silica sand in moist form poses no health risk and no inhalation risk. In the event that dust is generated, use local exhaust as required to maintain exposures as far as possible below applicable occupational exposure limits. Control of exposure to dust must be accomplished as far as feasible by accepted engineering control measures (e.g., enclosure or confinement of the operation, general or local exhaust ventilation, and substitution of less toxic materials.

Recommendations for personal protective measures

Local Exhaust: When working with silica sand products, use sufficient local exhaust to reduce the level of respirable dust to the applicable standards set forth in Section III. See ACGIH "Industrial Ventilation, A Manual of Recommended Practice," latest edition.

Respiratory Protection: Dust is generated when working with dry silica sand. To minimize exposure to dust and/or crystalline silica, the mixing of dry sand products should be conducted with sufficient ventilation.
Respirable dust and quartz levels should be monitored regularly. Dust and quartz levels in excess of appropriate exposure limits should be reduced by feasible engineering controls, including (but not limited to) wet suppression, ventilation, and process enclosure. When such controls are not feasible, NIOSH/MSHA approved respirators must be worn in accordance with a respiratory protection program which meets OSHA/MSHA requirements as set forth at 29 CFR1910.134 and ANSI Z88.2-2015"Practices for Respiratory Protection".

Eye Protection: Safety glasses with side shields that are compliant with ANSI Z787.1-1989

Skin Protection: Use gloves and/or protective clothing if abrasion or allergic reactions are experienced.

Work/Hygienic Practices: Avoid creating or breathing dust Always observe good personal hygiene measures, such as washing after handling material and before eating, drinking and/or smoking. Routinely wash work clothes and protective equipment to remove containments.

Section 9. Physical & Chemical Properties

Physical State	Granular
Appearance	Buff color in dry form
Odor	Earthy odor when wet
Odor Threshold	Not Applicable
pH	7.0
Solubility in Water	None
Melting Point	1710°C
Freezing Point	< 0 °C (<32°F)
Specific Gravity / Relative Density	2.65 g/cc
Evaporation Rate	No data available
Flash Point	Not Applicable
Auto-Ignition Temperature	Not Applicable
Decomposition Temperature	Not Applicable
Flammability	Not Applicable
Vapor Pressure	Not Applicable
Vapor Density	Not Applicable
Explosive Limits	Not Applicable
Viscosity	Not Applicable
Partition Coefficient: n-octanol/water	Not Applicable
Initial Boiling Point & Boiling Range	Not Applicable

Section 10. Stability & Reactivity

Reactivity Hazardous reactions will not occur under normal conditions.

Chemical stability Stable at standard temperature and pressure.

Possibility of hazardous reactions Hazardous polymerization will not occur.

Conditions to avoid None known.

Incompatible materials Powerful oxidizing agents such as fluorine, chlorine trifluoride, manganese trioxide, etc.

Hazardous decomposition products Silica will dissolve in hydrofluoric acid, producing a corrosive gas, silicon tetrafluoride.

Section 11. Toxicological Information

Routes of Exposure	Inhalation of silica sand dust, Ingestion
Acute Effects	
Inhalation	Aspiration of high concentrations of dry silica dust may cause mechanical irritation and discomfort. Long term exposure may cause chronic effects. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring.
Eye Contact	Not a primary eye irritant. May cause mechanical irritation.
Skin Contact/Irritation	Not a skin irritant. Not absorbed through skin.
Sensitization	Not a sensitizer

Ingestion	Ingestion may cause gastrointestinal irritation

Section 11. Toxicological Information

Chronic Effects	
Signs and Systems of Exposure	Exposure to dust may cause mucous membrane and respiratory irritation, cough, sore throat, nasal congestion, sneezing and shortness of breath.
Mutagenic Effects	None Known
Teratogenic Effects	None Known
Developmental Toxicity	None Known
Effects of Silicosis	**Symptoms of Silicosis**
Bronchitis/Chronic Obstructive Pulmonary Disorder. Tuberculosis – Silicosis makes an individual more susceptible to TB. Scleroderma – a disease affecting skin, blood vessels, joints and skeletal muscles. Possible renal disease.	Shortness of breath, possible fever, fatigue loss of appetite chest pain, dry cough, respiratory failure which may eventually lead to death. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop mycobacterial infections and fungal infections Inhalation of air with a very high concertation of respirable silica dust can cause the most serious forms of silicosis in a matter of months or a few years. Some epidemiological studies have concluded that there is a significant risk of developing silicosis even at airborne exposure levels that are equal to the NIOSH REL and ACGIH TLV
Remarks	
Carcinogenicity	The International Agency for Research on Cancer has determined that crystalline silica is carcinogenic to humans (Group 1). Refer to IRAC Monograph 100C (2011). The National Toxicology Program classifies respirable crystalline silica as " known to be a human carcinogen" (12th Report on Carcinogens, 2011). The ACGIH classifies crystalline silica, quartz as a suspected human carcinogen(A2)

Other Data with Possible Relevance to Human Health	There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of disease endpoints such as scleroderma, rheumatoid arthritis, systemic lupus, erythematosus, sarcoidosis, chronic bronchitis, chronic obstructive pulmonary disease, emphysema, chronic kidney disease and end stage renal disease.
Numerical Measures of toxicity	None Known

OSHA, IARC, and NTP Carcinogen Classifications					
Chemical with Carcinogen Potential		**CAS#**	**OSHA**	**IARC**	**NTP**
Quartz, (Crystalline Silica)	SiO2	CAS # 14808-60-7	Yes	Yes - Group 1	Yes

Section 12. Ecological Information (non-mandatory)

Ecotoxicity

Not expected to be harmful to aquatic organisms. Discharging sand dust and fines into waters may increase total suspended particulate levels that can be harmful to certain aquatic organisms

Chemical oxygen demand(COD) None Known

Products of Biodegradation None Known

Toxicity of the products of Biodegradation None Known

Bioaccumulation Potential None Known

Potential to move from soil to groundwater None Known

Other adverse effects None Known

13. Disposal Considerations

Personal Protection

Refer to Section 8: "Recommendations for Personal Protective Measures" when disposing of ceramic waste.

Appropriate disposal containers

Standard waste disposal containers – no specials requirements.

Appropriate disposal methods

Disposal of this product should comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. In most cases, this is normal waste disposal. The generation of waste should be avoided or minimized. Dispose of non-recyclable products via a licensed waste disposal contractor. Waste packaging should be recycled. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains, and sewers.

Physical and chemical properties that may affect disposal

Dry silica dust should be placed in a sealed container or in a manner that reduces or eliminates the release of the product. Packaging should be recycled before disposal.

Sewage disposal

Do not dispose of into sinks or toilets. They will clog. Never dispose of this product into a sewer system.

Special precautions for landfills or incineration activities

There are no special precautions for disposal in a landfill. This product is non-combustible and is not suitable for incineration.

Section 14. Transportation Information

Regulatory Information	UN Number	UN Proper Shipping Name	Transport Hazard Class	Packing Group Number	Bulk Transport Guidance	Special Precautions
DOT Classification	Not regulated	-	-	-	-	-
TDG Classification	Not regulated	-	-	-	-	-
ADR/RID Class	Not regulated	-	-	-	-	-
IMDG Class	Not regulated	-	-	-	-	-
IATA-DGR Class	Not regulated	-	-	-	-	-

Section 15. Regulatory Information

RCRA	Crystalline Silica (quartz) is not classified as a hazardous waste under the Resource Conservation and Recovery Act, or it's regulations 40 CFR 261et seq.
CERCLA Section 103 Reportable Quantity	None
Clean Air Act	Crystalline silica (quartz) mined and processed by Standard Sand & Silica, Co. was not processed with or does not contain any Class I or Class II ozone depleting substances
FDA	Silica is included in the list of substances

NTP	Respirable crystalline silica (quartz) is classified to be Known as a Human Carcinogen.
OSHA Hazard Communication Evaluation	Crystalline silica (quartz) meets criteria for hazardous Material, as defined by 29 CFR 1910.1200
California Inhalation Reference Exposure Level (REL)	California established a chronic REL ug for silica (Crystalline, respirable). A chronic REL is an airborne level of a substance at or below which no adverse effects are anticipated in individuals indefinitely exposed to the substance at that level.
Massachusetts Toxic Use Reduction Act	Silica, crystalline (respirable size <10 microns) is toxic For purposes of the Massachusetts Toxic Us Reduction Act.
Pennsylvania Worker and Community Right to Know Act	Quartz is a hazardous substance under the Act, but It is not a special hazardous substance or an Environmental hazardous substance.
Canada	All the components of this product are listed on the Canadian Domestic Substances List or exempt from Notification requirements. WHMIS Classification: Class D, Division 2, Subdivision A (Very Toxic Material Causing other Toxic Effects.
International Agency for Research on Cancer	Group 1
Toxic Substances Control Act (TSCA)	This chemical is listed on the TSCA Inventory, with no regulatory (SNUR or other) requirements.

National, State, provincial or local emergency planning, community right to know and other laws, regulations or ordnances may be applicable - consult applicable laws and all changes since the date of this Safety Data Sheet.

Section 16. Other Information

Definitions

ASTM means American Society of Testing and Materials
OSHA means Occupational Safety & Health Administration
IARC means International Agency for Research on Cancer
NTP means National Toxicology Program
HCS means Hazard Communication Standard
CAS means Chemical Abstract Service
ACGIH means American Conference of Governmental Industrial Hygienists
CAL-OSHA means California OSHA, most CAL-OSHA standards defer to the federal OSHA standards
OSHA PEL means OSHA Permissible Exposure Limit
OSHA STEL means short exposure for a duration of 15 minutes, that cannot be repeated more than 4 times per day, with at least 60 minutes between exposure periods
TWA means Time Weighted Average (average exposure on the basis of an 8h/day, 40h/week work schedule)
TLV means Threshold Limit Value - American Conference of Governmental Industrial Hygienists (ACGIH)

Three types of TLVs for chemical substances as defined by the ACGIH are:

1. **TLV-TWA** - Time weighted average - average exposure on the basis of an 8h/day, 40h/week work schedule.
2. **TLV-STEL** - Short-term exposure limit - spot exposure for a duration of 15 minutes, that cannot be repeated more than 4 times per day, with at least 60 minutes between exposure periods.
3. **TLV-C** - Ceiling limit - absolute exposure limit that should not be exceeded at any time.
4. **NFPA Hazard Rating**: Health: 1 Fire: 0 Reactivity: 0

This SDS is in compliance with The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) – June 1, 2015. This data sheet is subject to change without notice.

Information presented herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief but is not guaranteed to be so. Nothing herein is to be construed as recommending any practice or any product in violation of any patent or in violation of any law or regulation. It is the user's responsibility to determine for their self; the suitability of any material for a specific purpose and to adopt such safety precautions as may be necessary. We make no warranty as to the results to be obtained in using any material and, since conditions of use are not under our control, we must necessarily disclaim all liability with respect to the use of any material supplied by us.

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 Reviewed on 05/01/2018

Trade name: Shortening, Fats or Oils

* 1 Identification

· **Product identifier**

· **Trade name: Shortening, Fats or Oils**
· **CAS Number:**
68334-28-1
· **Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

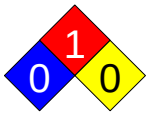
· **Details of the supplier of the safety data sheet**
· **Manufacturer/Supplier:**
Ag Processing Inc
12700 West Dodge
Rd. Omaha, NE 68154
Phone: 402-496-7809
· **Emergency telephone number:** 402-496-6688

* 2 Hazard(s) identification

· **Classification of the substance or mixture**
The substance is not classified according to the Globally Harmonized System (GHS).

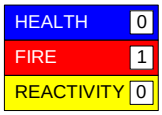
· **Label elements**
· **GHS label elements** Non-Regulated Material
· **Hazard pictograms** Non-Regulated Material
· **Signal word** Non-Regulated Material
· **Hazard statements** Non-Regulated Material
· **Unknown acute toxicity:**
100 percent of the mixture consists of ingredient(s) of unknown toxicity.

· **Classification system:**
· **NFPA ratings (scale 0 - 4)**



Health = 0
Fire = 1
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**



Health = 0
Fire = 1
Reactivity = 0

· **Hazard(s) not otherwise classified (HNOC):** None known

* 3 Composition/information on ingredients

· **Chemical characterization: Substances**
· **CAS No. Description**
68334-28-1 Partially Hydrogenated Vegetable Oil

4 First-aid measures

· **Description of first aid measures**
· **General information:** No special measures required.
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.

(Contd. on page 2)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 Reviewed on 05/01/2018

Trade name: Shortening, Fats or Oils

· ***After skin contact:***
Wash with soap and water.
Normal first aid procedures for treating burns should be employed if skin comes in contact with hot oil.
Dermatitis could result from prolonged residence on skin of allergy sensitive individuals.
· ***After eye contact:*** Rinse opened eye for several minutes under running water.
· ***After swallowing:*** If swallowed and symptoms occur, consult a doctor.
· ***Information for doctor:***
· ***Most important symptoms and effects, both acute and delayed:*** No further relevant information available.
· ***Indication of any immediate medical attention and special treatment needed***
No further relevant information available.

5 Fire-fighting measures

· ***Extinguishing media***
· ***Suitable extinguishing agents:***
CO2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· ***For safety reasons unsuitable extinguishing agents:*** Water with full jet
· ***Special hazards arising from the substance or mixture***
Rags soaked in any solvent present a fire hazard and should always be stored in UL listed or Factory Mutual approved, covered containers. Improperly stored rags can create conditions that lead to oxidation. Oxidation under certain conditions can lead to spontaneous combustion.
· ***Advice for firefighters***
· ***Protective equipment:***
As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.

6 Accidental release measures

· ***Personal precautions, protective equipment and emergency procedures*** Product is slippery when spilled.
· ***Environmental precautions:*** Do not allow to enter sewers/ surface or ground water.
· ***Methods and material for containment and cleaning up:***
Absorb with liquid-binding material (ie. sand, diatomite, acid binders, universal binders, sawdust).
Dispose of the collected material according to regulations.
· ***Reference to other sections***
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

· ***Handling:***
· ***Precautions for safe handling*** No special measures required.
· ***Information about protection against explosions and fires:*** No special measures required.
· ***Conditions for safe storage, including any incompatibilities***
· ***Storage:***
· ***Requirements to be met by storerooms and receptacles:*** No special requirements.
· ***Information about storage in one common storage facility:*** Not required.
· ***Further information about storage conditions:*** None.
· ***Specific end use(s)*** No further relevant information available.

(Contd. on page 3)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 *Reviewed on 05/01/2018*

Trade name: Shortening, Fats or Oils

* 8 Exposure controls/personal protection

· ***Additional information about design of technical systems:*** No further data; see section 7.

· ***Control parameters***

· ***Components with occupational exposure limits:***

68334-28-1 Partially Hydrogenated Vegetable Oil (100%)

Under normal uses and conditions, edible oils and fats pose no health hazard. If aspirated as an oil mist the respiratory system may be affected. Oil mist is considered a nuisance particulate by the American Conference of Governmental Industrial

Hygienists (ACGIH) who recommend a TLV of 10 ppm

· ***Additional information:*** The lists that were valid during the creation of this SDS were used as basis.

· ***Exposure controls***

· ***Personal protective equipment:***

· ***General protective and hygienic measures:***

Keep away from foodstuffs, beverages and feed.

Immediately remove all soiled and contaminated clothing and wash before reuse.

Breathing equipment: Not required.

· ***Protection of hands:*** Not required

· ***Material of gloves***

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

· ***Penetration time of glove material:*** Not applicable

(Contd. on page 4)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 *Reviewed on 05/01/2018*

Trade name: Shortening, Fats or Oils

*
9 Physical and chemical properties

· ***Information on basic physical and chemical properties***
· ***General Information***
· ***Appearance:***

Form:	Solid or Liquid
Color:	White to Yellow
· ***Odor:***	Light vegetable oil
· ***Odor threshold:***	Not determined.
· ***pH-value:***	Not determined.
· ***Change in condition***	
Melting point/Melting range:	3.2-130 °F (typical)
Boiling point/Boiling range:	>300°C @ 0.05 mm Hg >250°C @ 0.001 mm Hg
· ***Flash point:***	Not applicable.
· ***Flammability (solid, gaseous):***	Not applicable.
· ***Ignition temperature:***	
Decomposition temperature:	Not determined.
· ***Auto igniting:***	Not determined.
· ***Danger of explosion:***	Product does not present an explosion hazard.
· ***Explosion limits:***	
Lower:	Not determined.
Upper:	Not determined.
· ***Vapor pressure:***	Not determined.
· ***Density @ 20 °C (68 °F):***	0.698-0.921 g/cm³ (5.825-7.686 lbs/gal) (liquid)
· ***Relative density***	Not determined.
· ***Vapor density***	Not determined.
· ***Evaporation rate***	Not determined.
· ***Solubility in / Miscibility with***	
Water:	Insoluble.
· ***Partition coefficient (n-octanol/water):***	Not determined.
· ***Viscosity:***	
Dynamic:	Not determined.
Kinematic:	Not determined.
Organic solvents:	0.0 %
Solids content:	100.0 %
· ***Other information***	No further relevant information available.

(Contd. on page 5)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 *Reviewed on 05/01/2018*

Trade name: Shortening, Fats or Oils

10 Stability and reactivity

· ***Reactivity*** No further relevant information available.
· ***Chemical stability*** Stable under normal conditions.
· ***Thermal decomposition / conditions to be avoided:*** No decomposition if used according to specifications.
· ***Possibility of hazardous reactions*** No dangerous reactions known.
· ***Conditions to avoid*** No further relevant information available.
· ***Incompatible materials:*** No further relevant information available.
· ***Hazardous decomposition products:*** No dangerous decomposition products known.

* 11 Toxicological information

· ***Information on toxicological effects***
· ***Acute toxicity:***
· ***Primary irritant effect:***
· ***on the skin:*** No irritating effect.
· ***on the eye:*** No irritating effect.
· ***Additional toxicological information:***
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.
The substance is not subject to classification.

· ***Carcinogenic categories***
· ***IARC (International Agency for Research on Cancer)*** Substance is not listed.

· ***NTP (National Toxicology Program)***
Substance is not listed.
· ***OSHA-Ca (Occupational Safety & Health Administration)***
Substance is not listed.

12 Ecological information

· ***Toxicity***
· ***Aquatic toxicity:*** No further relevant information available.
· ***Persistence and degradability*** No further relevant information available.
· ***Behavior in environmental systems:***
· ***Bioaccumulative potential*** No further relevant information available.
· ***Mobility in soil*** No further relevant information available.
· ***Additional ecological information:***
· ***General notes:*** Not known to be hazardous to water.
· ***Results of PBT and vPvB assessment***
· ***PBT:*** Not applicable.
· ***vPvB:*** Not applicable.
· ***Other adverse effects*** No further relevant information available.

13 Disposal considerations

· ***Waste treatment methods***
· ***Recommendation:***
Small quantities can be disposed of with household waste.
Recycle or dispose with household trash.

(Contd. on page 6)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 *Reviewed on 05/01/2018*

Trade name: Shortening, Fats or Oils

· ***Uncleaned packagings:***
· ***Recommendation:*** Disposal must be made according to official regulations.

* 14 Transport information

· ***UN-Number***	
· ***DOT, ADN, IMDG, IATA***	Non-Regulated Material
· ***ADR***	Non-Regulated Material Not Regulated
· ***UN proper shipping name***	
· ***DOT, ADR, ADN, IMDG, IATA***	Non-Regulated Material
· ***Transport hazard class(es)***	
· ***DOT, ADR, ADN, IMDG, IATA***	
· ***Class***	Non-Regulated Material
· ***Packing group***	
· ***DOT, ADR, IMDG, IATA***	Non-Regulated Material
· ***Environmental hazards:***	Not applicable.
· ***Special precautions for user***	Not applicable.
· ***Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code***	Not applicable.
· ***UN "Model Regulation":***	-

* 15 Regulatory information

· ***Safety, health and environmental regulations/legislation specific for the substance or mixture***
· ***Sara***

· ***Section 355 (extremely hazardous substances):***
Substance is not listed.

· ***Section 313 (Specific toxic chemical listings):***
Substance is not listed.

· ***TSCA (Toxic Substances Control Act):***
Substance is listed.

· ***California Proposition 65***

· ***Chemicals known to cause cancer:***
Substance is not listed.

· ***Chemicals known to cause reproductive toxicity for females:***
Substance is not listed.

· ***Chemicals known to cause reproductive toxicity for males:***
Substance is not listed.

· ***Chemicals known to cause developmental toxicity:***
Substance is not listed.

· ***Carcinogenic categories***

· ***EPA (Environmental Protection Agency)***
Substance is not listed.

· ***TLV (Threshold Limit Value established by ACGIH)***
Substance is not listed.

(Contd. on page 7)

Safety Data Sheet (SDS)

OSHA HazCom Standard 29 CFR 1910.1200(g) and GHS Rev 03.

Issue date 04/28/2015 *Reviewed on 05/01/2018*

Trade name: Shortening, Fats or Oils

· ***NIOSH-Ca (National Institute for Occupational Safety and Health)***
Substance is not listed.

· ***GHS label elements***
Non-Regulated Material
· ***Hazard pictograms***
Non-Regulated Material

· ***Signal word***
Non-Regulated Material

· ***Hazard statements***
Non-Regulated Material

· ***National regulations:***
Substance is not listed.
· ***State Right to Know***
Substance is not listed.

· ***Chemical safety assessment:*** A Chemical Safety Assessment has not been carried out.

16 Other information

The information and recommendations in this safety data sheet are, to the best of our knowledge, accurate as of the date of issue. Nothing herein shall be deemed to create warranty, expressed or implied and shall not establish a legally valid contractual relationship. It is the responsibility of the user to determine applicability of this information and the suitability of the material or product for any particular purpose.

· ***Date of preparation / last revision*** 04/28/2015 /
· ***Abbreviations and acronyms:***
ADR: The European Agreement concerning the International Carriage of Dangerous Goods by Road
ADN: The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
Eye Irrit. 2B: Serious eye damage/eye irritation, Hazard Category 2B

STOT SE 3: Specific target organ toxicity - Single exposure, Hazard Category 3
· **** Data compared to the previous version altered.***
SDS created by MSDS Authoring Services www.msdsauthoring.com (877) 204-9106

SAFETY DATA SHEET

1. Identification

Product identifier **Oatey CPVC Heavy Duty Orange & Gray**

Other means of identification

Product code 1202E

Recommended use Joining CPVC Pipes

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name Oatey Co.

Address 4700 West 160th St.
Cleveland, OH 44135

Telephone 216-267-7100

E-mail info@oatey.com

Transport Emergency Chemtrec 1-800-424-9300 (Outside the US 1-703-527-3887)

Emergency First Aid 1-877-740-5015

Contact person MSDS Coordinator

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 2
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 2A
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
	Aspiration hazard	Category 1

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Highly flammable liquid and vapor. Harmful if swallowed. May be fatal if swallowed and enters airways. Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation. May cause drowsiness or dizziness.

Precautionary statement

Prevention Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing mist or vapor. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.

Response If swallowed: Immediately call a poison center/doctor. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a poison center/doctor if you feel unwell. Rinse mouth. Do NOT induce vomiting. If skin irritation occurs: Get medical advice/attention. If eye irritation persists: Get medical advice/attention. Take off contaminated clothing and wash before reuse. In case of fire: Use appropriate media to extinguish.

Storage	Store in a well-ventilated place. Keep container tightly closed. Keep cool. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis. May form explosive peroxides. Contains a chemical classified by the US EPA as a suspected possible carcinogen.

Supplemental information

Not applicable.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Furan, Tetrahydro-	109-99-9	50-70
Ethene, chloro-, homopolymer, chlorinated	68648-82-8	10-20
Acetone	67-64-1	5-15
Cyclohexanone	108-94-1	5-15
Silica, amorphous, fumed	112945-52-5	1-5

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.
Skin contact	Take off immediately all contaminated clothing. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
Ingestion	Call a physician or poison control center immediately. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Aspiration may cause pulmonary edema and pneumonitis.
Most important symptoms/effects, acute and delayed	Irritation of nose and throat. Aspiration may cause pulmonary edema and pneumonitis. Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause respiratory irritation. Vapors have a narcotic effect and may cause headache, fatigue, dizziness and nausea. Skin irritation. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off all contaminated clothing immediately. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Alcohol resistant foam. Water fog. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Vapors may form explosive mixtures with air. Vapors may travel considerable distance to a source of ignition and flash back. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	Highly flammable liquid and vapor. This product contains tetrahydrofuran that may form explosive organic peroxide when exposed to air or light or with age.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Wear appropriate protective equipment and clothing during clean-up. Avoid breathing mist or vapor. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up

Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Take precautionary measures against static discharge. Use only non-sparking tools. Keep combustibles (wood, paper, oil, etc.) away from spilled material. This product is miscible in water.

Large Spills: Stop the flow of material, if this is without risk. Use water spray to reduce vapors or divert vapor cloud drift. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Prevent entry into waterways, sewer, basements or confined areas. Following product recovery, flush area with water.

Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.

Environmental precautions

Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling

Vapors may form explosive mixtures with air. Do not handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Explosion-proof general and local exhaust ventilation. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. Avoid breathing mist or vapor. Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Do not taste or swallow. When using, do not eat, drink or smoke. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep away from heat, sparks and open flame. Prevent electrostatic charge build-up by using common bonding and grounding techniques. Store in a cool, dry place out of direct sunlight. Store in original tightly closed container. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Acetone (CAS 67-64-1)	PEL	2400 mg/m3 1000 ppm
Cyclohexanone (CAS 108-94-1)	PEL	200 mg/m3 50 ppm
Furan, Tetrahydro- (CAS 109-99-9)	PEL	590 mg/m3 200 ppm

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value
Silica, amorphous, fumed (CAS 112945-52-5)	TWA	0.8 mg/m3 20 mppcf

US. ACGIH Threshold Limit Values

Components	Type	Value
Acetone (CAS 67-64-1)	STEL	750 ppm
	TWA	500 ppm
Cyclohexanone (CAS 108-94-1)	STEL	50 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
	TWA	20 ppm
Furan, Tetrahydro- (CAS 109-99-9)	STEL	100 ppm
	TWA	50 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Acetone (CAS 67-64-1)	TWA	590 mg/m3
		250 ppm
Cyclohexanone (CAS 108-94-1)	TWA	100 mg/m3
		25 ppm
Furan, Tetrahydro- (CAS 109-99-9)	STEL	735 mg/m3
		250 ppm
	TWA	590 mg/m3
		200 ppm
Silica, amorphous, fumed (CAS 112945-52-5)	TWA	6 mg/m3

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Acetone (CAS 67-64-1)	50 mg/l	Acetone	Urine	*
Cyclohexanone (CAS 108-94-1)	80 mg/l	1,2-Cyclohexanediol, with hydrolysis	Urine	*
	8 mg/l	Cyclohexanol, with hydrolysis	Urine	*
Furan, Tetrahydro- (CAS 109-99-9)	2 mg/l	Tetrahydrofuran	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

US - Minnesota Haz Subs: Skin designation applies

Cyclohexanone (CAS 108-94-1) Skin designation applies.

US - Tennessee OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Furan, Tetrahydro- (CAS 109-99-9) Can be absorbed through the skin.

US. NIOSH: Pocket Guide to Chemical Hazards

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Appropriate engineering controls Explosion-proof general and local exhaust ventilation. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection Face shield is recommended. Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Wear appropriate chemical resistant gloves.

Other Wear appropriate chemical resistant clothing.

Respiratory protection If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.

Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	When using, do not eat, drink or smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Form	Translucent liquid.
Color	Orange
Odor	Solvent.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	151 °F (66.11 °C)
Flash point	14.0 - 23.0 °F (-10.0 - -5.0 °C)
Evaporation rate	5.5 - 8
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	1.8
Flammability limit - upper (%)	11.8
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	145 mm Hg @ 20 C
Vapor density	2.5
Relative density	0.97 +/- 0.02
Solubility(ies)	
Solubility (water)	Negligible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	500 - 1500 cP
Other information	
Bulk density	8.1 lb/gal
VOC (Weight %)	<490 g/l SQACMD 1168/M316A

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid heat, sparks, open flames and other ignition sources. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Acids. Strong oxidizing agents. Ammonia. Amines. Isocyanates. Caustics.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May be fatal if swallowed and enters airways. Headache. Nausea, vomiting. May cause irritation to the respiratory system. Vapors have a narcotic effect and may cause headache, fatigue, dizziness and nausea. Prolonged inhalation may be harmful.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye irritation.
Ingestion	May be fatal if swallowed and enters airways. Harmful if swallowed. Harmful if swallowed. Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Aspiration may cause pulmonary edema and pneumonitis. Severe eye irritation. Symptoms may include stinging, tearing, redness, swelling, and blurred vision. May cause respiratory irritation. Skin irritation. May cause redness and pain. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Information on toxicological effects

Acute toxicity May be fatal if swallowed and enters airways. Narcotic effects. May cause respiratory irritation.

Components	Species	Test Results
Acetone (CAS 67-64-1)		
Acute		
Dermal		
LD50	Rabbit	20 ml/kg
Inhalation		
LC50	Rat	50 mg/l, 8 Hours
Oral		
LD50	Rat	5800 mg/kg
Cyclohexanone (CAS 108-94-1)		
Acute		
Dermal		
LD50	Rabbit	948 mg/kg
Inhalation		
LC50	Rat	8000 ppm, 4 hours
Oral		
LD50	Rat	1540 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye irritation.

Respiratory or skin sensitization

Respiratory sensitization	Not available.
Skin sensitization	This product is not expected to cause skin sensitization.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	In 2012 USEPA Integrated Risk Information System (IRIS) reviewed a two species inhalation lifetime study on THF conducted by NTP (1998). Male rats developed renal tumors and female mice developed liver tumors while neither the female rats nor the male mice showed similar results. Because the carcinogenic mechanisms could not be identified clearly in either species for either tumor, the EPA determined that the male rat and female mouse findings are relevant to the assessment of carcinogenic potential in humans. Therefore, the IRIS review concludes that these data in aggregate indicate that there is "suggestive evidence of carcinogenic potential" following exposure to THF by all routes of exposure.

IARC Monographs. Overall Evaluation of Carcinogenicity

Cyclohexanone (CAS 108-94-1)	3 Not classifiable as to carcinogenicity to humans.
Silica, amorphous, fumed (CAS 112945-52-5)	3 Not classifiable as to carcinogenicity to humans.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Narcotic effects. May cause drowsiness and dizziness. Respiratory tract irritation.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Prolonged inhalation may be harmful.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Acetone (CAS 67-64-1)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	> 100 mg/l, 96 hours
Cyclohexanone (CAS 108-94-1)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	481 - 578 mg/l, 96 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Partition coefficient n-octanol / water (log Kow)

Acetone (CAS 67-64-1)	-0.24
Cyclohexanone (CAS 108-94-1)	0.81
Furan, Tetrahydro- (CAS 109-99-9)	0.46

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. This material and its container must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number UN1133

UN proper shipping name Adhesives

Transport hazard class(es)

Class 3

Subsidiary risk -

Label(s) 3

Packing group II

Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

Special provisions	T11, TP1, TP8, TP27
Packaging exceptions	150
Packaging non bulk	201
Packaging bulk	243

IATA

UN number	UN1133
UN proper shipping name	Adhesives
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	II
Environmental hazards	No.
ERG Code	3L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN1133
UN proper shipping name	ADHESIVES
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	II
Environmental hazards	
Marine pollutant	No.
EmS	F-E, S-D
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not available.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Acetone (CAS 67-64-1)	LISTED
Cyclohexanone (CAS 108-94-1)	LISTED
Furan, Tetrahydro- (CAS 109-99-9)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Acetone (CAS 67-64-1)	6532

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Acetone (CAS 67-64-1)	35 %WV

DEA Exempt Chemical Mixtures Code Number

Acetone (CAS 67-64-1)	6532

US state regulations

US. Massachusetts RTK - Substance List

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Furan, Tetrahydro- (CAS 109-99-9)
Silica, amorphous, fumed (CAS 112945-52-5)

US. New Jersey Worker and Community Right-to-Know Act

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Furan, Tetrahydro- (CAS 109-99-9)

US. Pennsylvania Worker and Community Right-to-Know Law

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Furan, Tetrahydro- (CAS 109-99-9)
Silica, amorphous, fumed (CAS 112945-52-5)

US. Rhode Island RTK

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Furan, Tetrahydro- (CAS 109-99-9)

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 27-May-2015

Revision date -

Version # 01

HMIS® ratings
Health: 2
Flammability: 3
Physical hazard: 0

NFPA ratings

Disclaimer The information in the sheet was written based on the best knowledge and experience currently available. Oatey Co. cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use.

SAFETY DATA SHEET

1. Identification

Product identifier **White Lithium Grease**

Other means of identification

Product Code No. 03080 (Item# 1003341)

Recommended use Lubricating grease

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Manufactured or sold by:

Company name CRC Industries, Inc.

Address 885 Louis Dr.
Warminster, PA 18974 US

Telephone

General Information 215-674-4300

Technical Assistance 800-521-3168

Customer Service 800-272-4620

24-Hour Emergency 800-424-9300 (US)

(CHEMTREC) 703-527-3887 (International)

Website www.crcindustries.com

2. Hazard(s) identification

Physical hazards	Flammable aerosols	Category 1
	Gases under pressure	Liquefied gas
Health hazards	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 2B
	Reproductive toxicity (fertility)	Category 2
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
	Aspiration hazard	Category 1
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 2
	Hazardous to the aquatic environment, long-term hazard	Category 2

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Extremely flammable aerosol. Contains gas under pressure; may explode if heated. May be fatal if swallowed and enters airways. Causes skin irritation. Causes eye irritation. May cause drowsiness or dizziness. Suspected of damaging fertility. Toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Do not spray on an open flame or other ignition source. Pressurized container: Do not pierce or burn, even after use. Do not apply while equipment is energized. Extinguish all flames, pilot lights and heaters. Vapors will accumulate readily and may ignite. Use only with adequate ventilation; maintain ventilation during use and until all vapors are gone. Open doors and windows or use other means to ensure a fresh air supply during use and while product is drying. If you experience any symptoms listed on this label, increase ventilation or leave the area. Avoid breathing mist or vapor. Wash thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection. Avoid release to the environment.
Response	If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If on skin: Wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse. If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention. If exposed or concerned: Get medical advice/attention. Collect spillage.
Storage	Store in a well-ventilated place. Store locked up. Protect from sunlight. Do not expose to temperatures exceeding 50°C/122°F. Exposure to high temperature may cause can to burst.
Disposal	Dispose of contents/container in accordance with local/regional/national regulations.
Hazard(s) not otherwise classified (HNOC)	Static accumulating flammable liquid can become electrostatically charged even in bonded and grounded equipment. Sparks may ignite liquid and vapor. May cause flash fire or explosion.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
liquefied petroleum gas		68476-86-8	30 - 40
2-methylpentane		107-83-5	20 - 30
distillates (petroleum), hydrotreated heavy naphthenic		64742-52-5	10 - 20
naphtha (petroleum), hydrotreated light		64742-49-0	10 - 20
n-hexane		110-54-3	3 - 5
zinc oxide		1314-13-2	< 1
2,2-dimethylbutane		75-83-2	< 0.3
2,3-dimethylbutane		79-29-8	< 0.3
3-methylpentane		96-14-0	< 0.3
calcium bis(dinonylnaphthalenesulphonate)		57855-77-3	< 0.3

Specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.
Skin contact	Remove contaminated clothing. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention. Wash contaminated clothing before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
Ingestion	Call a physician or poison control center immediately. Rinse mouth. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Most important symptoms/effects, acute and delayed	Aspiration may cause pulmonary edema and pneumonitis. May cause drowsiness and dizziness. Headache. Nausea, vomiting. Irritation of eyes. Exposed individuals may experience eye tearing, redness, and discomfort. Skin irritation. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.
General information	IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Carbon dioxide (CO2). Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Contents under pressure. Pressurized container may rupture when exposed to heat or flame. This product is a poor conductor of electricity and can become electrostatically charged. If sufficient charge is accumulated, ignition of flammable mixtures can occur. Static electricity accumulation may be significantly increased by the presence of small quantities of water or other contaminants. Material will float and may ignite on surface of water. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.
Fire-fighting equipment/instructions	In case of fire: Stop leak if safe to do so. Move containers from fire area if you can do so without risk. Containers should be cooled with water to prevent vapor pressure build up.
General fire hazards	Extremely flammable aerosol. Contents under pressure. Pressurized container may rupture when exposed to heat or flame.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Remove all possible sources of ignition in the surrounding area. Keep out of low areas. Many gases are heavier than air and will spread along ground and collect in low or confined areas (sewers, basements, tanks). Wear appropriate protective equipment and clothing during clean-up. Avoid breathing mist or vapor. Emergency personnel need self-contained breathing equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Use appropriate containment to avoid environmental contamination. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Keep combustibles (wood, paper, oil, etc.) away from spilled material. The product is immiscible with water and will spread on the water surface. Prevent product from entering drains. Stop the flow of material, if this is without risk. Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid release to the environment. Inform appropriate managerial or supervisory personnel of all environmental releases. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground. Use appropriate containment to avoid environmental contamination.

7. Handling and storage

Precautions for safe handling	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Minimize fire risks from flammable and combustible materials (including combustible dust and static accumulating liquids) or dangerous reactions with incompatible materials. Pressurized container: Do not pierce or burn, even after use. Do not use if spray button is missing or defective. Do not spray on a naked flame or any other incandescent material. Do not smoke while using or until sprayed surface is thoroughly dry. Do not cut, weld, solder, drill, grind, or expose containers to heat, flame, sparks, or other sources of ignition. Use caution around energized equipment. The metal container will conduct electricity if it contacts a live source. This may result in injury to the user from electrical shock and/or flash fire. Protect containers from physical damage; do not drag, roll, slide, or drop. When moving containers, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport containers. Avoid breathing mist or vapor. Avoid contact with eyes, skin, and clothing. Avoid prolonged exposure. Pregnant or breastfeeding women must not handle this product. Should be handled in closed systems, if possible. Use only in well-ventilated areas. Wear appropriate personal protective equipment. Wash hands thoroughly after handling. Avoid release to the environment. Observe good industrial hygiene practices. For product usage instructions, see the product label.
Conditions for safe storage, including any incompatibilities	Level 3 Aerosol. Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50°C/122 °F. Do not puncture, incinerate or crush. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. Avoid spark promoters. These alone may be insufficient to remove static electricity. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)	PEL	5 mg/m3	Mist.
		2000 mg/m3	
		500 ppm	
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)	PEL	400 mg/m3	
		100 ppm	
n-hexane (CAS 110-54-3)	PEL	1800 mg/m3	
		500 ppm	
zinc oxide (CAS 1314-13-2)	PEL	5 mg/m3	Respirable fraction.
		5 mg/m3	Fume.
		15 mg/m3	Total dust.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
2,2-dimethylbutane (CAS 75-83-2)	STEL	1000 ppm	
	TWA	500 ppm	
2,3-dimethylbutane (CAS 79-29-8)	STEL	1000 ppm	
	TWA	500 ppm	
2-methylpentane (CAS 107-83-5)	STEL	1000 ppm	
	TWA	500 ppm	
3-methylpentane (CAS 96-14-0)	STEL	1000 ppm	
	TWA	500 ppm	
distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)	TWA	5 mg/m3	Inhalable fraction.
n-hexane (CAS 110-54-3)	TWA	50 ppm	
zinc oxide (CAS 1314-13-2)	STEL	10 mg/m3	Respirable fraction.
	TWA	2 mg/m3	Respirable fraction.

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Components	Type	Value	Form
2,2-dimethylbutane (CAS 75-83-2)	Ceiling	1800 mg/m3	
		510 ppm	
	TWA	350 mg/m3	
		100 ppm	
2,3-dimethylbutane (CAS 79-29-8)	Ceiling	1800 mg/m3	
		510 ppm	
	TWA	350 mg/m3	
		100 ppm	
2-methylpentane (CAS 107-83-5)	Ceiling	1800 mg/m3	
		510 ppm	
	TWA	350 mg/m3	
		100 ppm	

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
3-methylpentane (CAS 96-14-0)	Ceiling	1800 mg/m3	
		510 ppm	
	TWA	350 mg/m3	
		100 ppm	
distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)	Ceiling	1800 mg/m3	
	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)	TWA	400 mg/m3	
		100 ppm	
n-hexane (CAS 110-54-3)	TWA	180 mg/m3	
		50 ppm	
zinc oxide (CAS 1314-13-2)	Ceiling	15 mg/m3	Dust.
	STEL	10 mg/m3	Fume.
	TWA	5 mg/m3	Fume.
		5 mg/m3	Dust.

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
n-hexane (CAS 110-54-3)	0.4 mg/l	2,5-Hexanedion, without hydrolysis	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

n-hexane (CAS 110-54-3) Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

n-hexane (CAS 110-54-3) Can be absorbed through the skin.

Appropriate engineering controls Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Provide eyewash station. Eye wash fountain and emergency showers are recommended.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Wear protective gloves such as: Nitrile. Polyvinyl chloride (PVC). Viton/butyl.

Other Wear appropriate chemical resistant clothing.

Respiratory protection If engineering controls are not feasible or if exposure exceeds the applicable exposure limits, use a NIOSH-approved cartridge respirator with an organic vapor cartridge. Use a self-contained breathing apparatus in confined spaces and for emergencies. Air monitoring is needed to determine actual employee exposure levels.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations Observe any medical surveillance requirements. When using do not smoke. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Physical state Liquid.

Form	Aerosol. Grease.
Color	Off-white.
Odor	Solvent.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	-244.7 °F (-153.7 °C) estimated
Initial boiling point and boiling range	118.4 °F (48 °C) estimated
Flash point	< 0 °F (< -17.8 °C) Tag Closed Cup
Evaporation rate	Fast.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	1 % estimated
Flammability limit - upper (%)	8 % estimated
Vapor pressure	2377.8 hPa estimated
Vapor density	> 1 (air = 1)
Relative density	0.64 estimated
Solubility (water)	Insoluble.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	437 °F (225 °C) estimated
Decomposition temperature	Not available.
Viscosity (kinematic)	Not available.
Percent volatile	98.4 % estimated

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Heat, flames and sparks. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause drowsiness and dizziness. Headache. Nausea, vomiting. Prolonged inhalation may be harmful.
Skin contact	Causes skin irritation.
Eye contact	Causes eye irritation.
Ingestion	Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia.
Symptoms related to the physical, chemical and toxicological characteristics	Aspiration may cause pulmonary edema and pneumonitis. May cause drowsiness and dizziness. Headache. Nausea, vomiting. Irritation of eyes. Exposed individuals may experience eye tearing, redness, and discomfort. Skin irritation. May cause redness and pain.

Information on toxicological effects

Acute toxicity	May be fatal if swallowed and enters airways.

Components	Species	Test Results
calcium bis(dinonylnaphthalenesulphonate) (CAS 57855-77-3)		
Acute		
Dermal		
LD50	Rabbit	> 20 g/kg
Oral		
LD50	Rat	> 5000 mg/kg
distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Oral		
LD50	Rat	> 5000 mg/kg
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
n-hexane (CAS 110-54-3)		
Acute		
Dermal		
LD50	Rabbit	> 1300 mg/kg
Oral		
LD50	Rat	15840 mg/kg
zinc oxide (CAS 1314-13-2)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Causes eye irritation.

Respiratory sensitization Not a respiratory sensitizer.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity Suspected of damaging fertility.

Specific target organ toxicity - single exposure May cause drowsiness and dizziness.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed and enters airways. If aspirated into lungs during swallowing or vomiting, may cause chemical pneumonia, pulmonary injury or death.

Chronic effects Prolonged inhalation may be harmful.

12. Ecological information

Ecotoxicity Toxic to aquatic life with long lasting effects.

Components		Species	Test Results
2-methylpentane (CAS 107-83-5)			
Aquatic			
Acute			
Crustacea	EC50	Daphnia	1 - 10 mg/l, 48 hours
Fish	LC50	Fish	1 - 10 mg/l, 96 hours
distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1000 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	5000 mg/l, 96 hours
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)			
Aquatic			
Acute			
Crustacea	EC50	Daphnia	1 - 10 mg/l, 48 hours
Fish	LC50	Fish	1 - 10 mg/l, 96 hours
n-hexane (CAS 110-54-3)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	2.101 - 2.981 mg/l, 96 hours
zinc oxide (CAS 1314-13-2)			
Aquatic			
Acute			
Crustacea	EC50	Water flea (Daphnia magna)	0.098 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	1.1 mg/l, 96 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability

Bioaccumulative potential

Partition coefficient n-octanol / water (log Kow)	
2,2-dimethylbutane	3.82
2,3-dimethylbutane	3.42
2-methylpentane	3.74
3-methylpentane	3.6
n-hexane	3.9
Bioconcentration factor (BCF)	
naphtha (petroleum), hydrotreated light	10 - 25000
zinc oxide	60690

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal of waste from residues / unused products If discarded, this product is considered a RCRA ignitable waste, D001. Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Contents under pressure. Do not puncture, incinerate or crush. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose in accordance with all applicable regulations.

Hazardous waste code D001: Waste Flammable material with a flash point <140 F

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number	UN1950
UN proper shipping name	Aerosols, flammable, Limited Quantity
Transport hazard class(es)	
Class	2.1
Subsidiary risk	-
Label(s)	2.1
Packing group	Not applicable.
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	N82
Packaging exceptions	306
Packaging non bulk	None
Packaging bulk	None

IATA

UN number	UN1950
UN proper shipping name	Aerosols, flammable, Limited Quantity
Transport hazard class(es)	
Class	2.1
Subsidiary risk	-
Packing group	Not applicable.
ERG Code	10L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Passenger and cargo aircraft	Allowed with restrictions.
Cargo aircraft only	Allowed with restrictions.

IMDG

UN number	UN1950
UN proper shipping name	AEROSOLS, LIMITED QUANTITY
Transport hazard class(es)	
Class	2
Subsidiary risk	-
Packing group	Not applicable.
Environmental hazards	
Marine pollutant	No.
EmS	Not available.
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not regulated.

US EPCRA (SARA Title III) Section 313 - Toxic Chemical: Listed substance

n-hexane (CAS 110-54-3)
zinc oxide (CAS 1314-13-2)

CERCLA Hazardous Substance List (40 CFR 302.4)

n-hexane (CAS 110-54-3)	Listed.
zinc oxide (CAS 1314-13-2)	Listed.

CERCLA Hazardous Substances: Reportable quantity

n-hexane (CAS 110-54-3)	5000 LBS

Spills or releases resulting in the loss of any ingredient at or above its RQ require immediate notification to the National Response Center (800-424-8802) and to your Local Emergency Planning Committee.

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

n-hexane (CAS 110-54-3)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA) Not regulated.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Section 311/312 Hazard categories Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - Yes
Pressure Hazard - Yes
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

US state regulations

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)
liquefied petroleum gas (CAS 68476-86-8)
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)
n-hexane (CAS 110-54-3)

US. New Jersey Worker and Community Right-to-Know Act

2,2-dimethylbutane (CAS 75-83-2)
2,3-dimethylbutane (CAS 79-29-8)
2-methylpentane (CAS 107-83-5)
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)
n-hexane (CAS 110-54-3)
zinc oxide (CAS 1314-13-2)

US. Massachusetts RTK - Substance List

2,2-dimethylbutane (CAS 75-83-2)
2,3-dimethylbutane (CAS 79-29-8)
2-methylpentane (CAS 107-83-5)
3-methylpentane (CAS 96-14-0)
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)
n-hexane (CAS 110-54-3)
zinc oxide (CAS 1314-13-2)

US. Pennsylvania Worker and Community Right-to-Know Law

2,2-dimethylbutane (CAS 75-83-2)
2,3-dimethylbutane (CAS 79-29-8)
2-methylpentane (CAS 107-83-5)
3-methylpentane (CAS 96-14-0)
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)
n-hexane (CAS 110-54-3)
zinc oxide (CAS 1314-13-2)

US. Rhode Island RTK

distillates (petroleum), hydrotreated heavy naphthenic (CAS 64742-52-5)
naphtha (petroleum), hydrotreated light (CAS 64742-49-0)
n-hexane (CAS 110-54-3)

US. California Proposition 65

WARNING: This product contains a chemical known to the State of California to cause cancer.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

titanium dioxide (CAS 13463-67-7) Listed: September 2, 2011

Volatile organic compounds (VOC) regulations

EPA

VOC content (40 CFR 51.100(s)) 100 %

Consumer products (40 CFR 59, Subpt. C) Not regulated

State

Consumer products	Not regulated (semi-solid lubricant)
VOC content (CA)	84.7 %
VOC content (OTC)	84.7 %

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	01-16-2015
Revision date	10-06-2017
Prepared by	Allison Yoon
Version #	03
Further information	CRC # 568F-G/1002591-1002592
HMIS® ratings	Health: 2* Flammability: 4 Physical hazard: 0 Personal protection: B
NFPA ratings	Health: 2 Flammability: 4 Instability: 0
NFPA ratings	

Disclaimer

The information contained in this document applies to this specific material as supplied. It may not be valid for this material if it is used in combination with any other materials. This information is accurate to the best of CRC's knowledge or obtained from sources believed by CRC to be accurate. Before using any product, read all warnings and directions on the label. For further clarification of any information contained on this (M)SDS consult your supervisor, a health & safety professional, or CRC Industries, Inc..

Revision Information

Product and Company Identification: Product Codes
Physical & Chemical Properties: Multiple Properties
Transport Information: Agency Name, Packaging Type, and Transport Mode Selection
Other information, including date of preparation or last revision: Further information

Safety Data Sheet

OSHA Hazard Communication Standard 29 CFR 1910.1200. Prepared to GHS Rev 3.

Revision date: July 13, 2016
REV: 1 **Date of issue: Aug 16, 2015**

Product name: AW Hydraulic Oil ISO 46

SECTION 1: Identification

Product identifier: **AW Hydraulic Oil ISO 46.**
Synonyms: Standard Hydraulic Oil.
Product Code Number: 9616, 9636, 9637, 9638.
SDS number: CGF001
Recommended use: Standard Hydraulic Oil.
Recommended restrictions: None known.

Manufacturer/Importer/Supplier/Distributor information:

Company Name: SPX Hydraulic Technologies.
Company Address: 5885 11th Street
Rockford, IL 61109
Company Telephone: Office hours (Mon – Fri)
8.00am – 5:00pm (CST)
(815) 874-5556
Company Contact Name: EH&S Department.
Emergency phone number: INFOTRAC 24 Hour Emergency Numbers:
USA, Canada, Puerto Rico (800) 535-5053.
International (352) 323-3500.

SECTION 2: Hazard(s) identification

Classification of the chemical in accordance with paragraph (d) of §1910.1200:

Physical hazards
No physical hazards for this product.

Health hazards
Not expected to be a health hazard when used under normal conditions.

Environmental hazards
No environmental hazards for this product.

GHS Signal word: **No signal word required.**

GHS Hazard statement(s): Not expected to be a health hazard when used under normal conditions.

GHS Hazard symbol(s): No Hazard Symbol required

GHS Precautionary statement(s): Not applicable

Hazard(s) not otherwise Classified (HNOC): Causes necrosis if injected into/under the skin. An aspiration hazard may be valid if the oil is vaporized under pressure.

Percentage of ingredient(s) of unknown acute toxicity:
Not applicable

SECTION 3: Composition/information on ingredients

Mixture: Highly refined mineral oils and additives.

Chemical name	Concentration (weight %)	CAS#
Distillates (petroleum), solvent- dewaxed heavy paraffinic	0-95 %	64742-65-0
Distillates (petroleum), hydro treated - heavy paraffinic	0-60%	64742-54-7
Paraffin oils (petroleum), catalytic - dewaxed light	0-60%	64742-71-8
Additive	<1 %	Proprietary

The specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret due to the proprietary nature of one of the components.

SECTION 4: First-aid Measures

Description of necessary measures:
Inhalation: Move to fresh air. Treat symptomatically. See Section 8 for additional measures to reduce or eliminate exposure. If symptoms persist, seek medical attention.

Skin contact: Wash area of contact thoroughly with soap and water. If symptoms persist, seek medical attention.

Eye contact: If eyes become irritated, flush immediately with copious amounts of lukewarm water for at least 15 minutes. If easy to do, remove contact lenses. Get medical attention if irritation persists.

Ingestion: DO NOT induce vomiting. Consult a physician if necessary.

Most important symptoms/effects, acute and delayed: Not expected to be a health hazard when used under normal conditions. An aspiration hazard may be appropriate if the oil is vaporized under pressure.

Indication of immediate medical attention and special treatment needed: None known

SECTION 5: Fire-fighting measures

Suitable extinguishing media: Water spray, Carbon dioxide, Dry chemical, Alcohol foam
Unsuitable extinguishing media: Do not use water jet.

Specific hazards arising from the chemical: Hazardous combustion products may include carbon monoxide and other toxic gases/vapors.

Special protective equipment and precautions for fire-fighters: Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Fight fire from a protected location. Water may be ineffective in fighting the fire. Use water spray to keep fire-exposed container cool.

SECTION 6: Accidental release measures

Personal precautions, protective equipment and emergency procedures:
Wear appropriate personal protective equipment (see Section 8). Do not breathe fumes or vapor.

Methods and materials for containment and cleaning up:
Eliminate sources of ignition. Stop source of leak if safe. Prevent entry into waterways and sewer systems. Absorb in vermiculite, dry sand or earth. Sweep up and place in a clearly labeled container for chemical waste.

SECTION 7: Handling and Storage

Precautions for safe handling: Avoid breathing mist or vapors. Avoid contact with eyes. Use only with adequate ventilation. Wash thoroughly after handling. Observe good personal hygiene practices. Change protective gloves/clothing when signs of contamination appear. Keep out of reach of children.

Conditions for safe storage, including any incompatibles: Store in original factory container in a dry area. Do not transfer to an unmarked container. Keep container tightly closed and in a well-ventilated place. Store away from heat and light.

SECTION 8: Exposure controls/personal protection

Control Parameters:
Occupational exposure limits:

US OSHA HAZARDOUS COMPONENTS (29 CFR 1910.1200): Permissible Exposure Limits		
Substance	**PEL-TWA (8 hour)**	**PEL-STEL (15 min)**
Oil mist, mineral	5 mg/m^3	No data available
Distillates (petroleum), hydro	No data available	No data available

treated - heavy paraffinic		
Paraffin oils (petroleum), catalytic - dewaxed light	No data available	No data available
Additive	No data available	No data available

US ACGIH Threshold Limit Values		
Substance	**TLV-TWA (8 hour)**	**TLV-STEL (15 min)**
Oil mist, mineral	5 mg/m^3	No data available
Distillates (petroleum), hydro treated - heavy paraffinic	No data available	No data available
Paraffin oils (petroleum), catalytic - dewaxed light	No data available	No data available
Additive	No data available	No data available

US NIOSH Guidelines		
Substance	**REL (10 hour)**	**STEL**
Oil mist, mineral	5 mg/m^3	10 mg/m^3
Distillates (petroleum), hydro treated - heavy paraffinic	No data available	No data available
Paraffin oils (petroleum), catalytic - dewaxed light	No data available	No data available
Additive	No data available	No data available

Appropriate engineering controls: Maintain air concentrations below occupational exposure standards using engineering controls if necessary. Local exhaust ventilation is recommended. Eye wash station and showers required for emergency use.

Individual protection measures, such as personal protective equipment:

Eye/face protection: Wear safety glasses or full face shield if splashes are likely to occur Approved to the appropriate OSHA standard. If possible, have eye-washing facilities readily available where eye irritation can occur.

Skin and Hand protection: Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g.US: F739) made from the following materials may provide suitable chemical protection: PVC, neoprene or nitrile rubber gloves. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, glove thickness, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.

Respiratory protection: No respiratory protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should

be taken to avoid breathing of material. If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103.

Other: Use as necessary to prevent exposure. Work clothing should be changed daily. Contaminated clothing should be removed and washed thoroughly before re-using.

Thermal hazards: No data available.

SECTION 9: Physical and chemical properties

Appearance	
Physical state:	Liquid
Form:	Liquid
Color:	Blue
Odor:	Mild
Odor threshold:	Not available
pH:	Not available
Melting point/freezing point:	Not available
Initial boiling point and boiling range:	Not available
Flash point:	>380 ˚F
Evaporation rate:	Not available
Flammability (solid, gas):	Not available
Upper/lower flammability or explosive limits	
Flammability limit – lower %):	Not available
Flammability limit – upper(%):	Not available
Explosive limit – lower (%):	Not available
Explosive limit – upper (%):	Not available
Vapor pressure:	Not available
Vapor density:	Not available
Relative density:	0.87 -0.89
Solubility(ies):	Insoluble
Partition coefficient (n-octanol/water):	Not available.
Auto-ignition temperature:	Not available
Decomposition temperature:	Not available
Viscosity:	46 cSt @40 degrees C

Other information	
Bulk density:	Not available
Flash point class:	Not available
VOC (Weight %):	Not available

SECTION 10: Stability and Reactivity

Reactivity: None known
Chemical stability: Stable
Possibility of hazardous reactions: None known
Conditions to avoid: Heat, sparks, flames.
Incompatible materials: Strong oxidizing agents.
Hazardous decomposition Products: Carbon monoxide, Carbon dioxide

SECTION 11: Toxicological information

Information on likely routes of exposure:

Inhalation: Not expected to be a primary route of exposure.
Ingestion: Not expected to be a primary route of exposure.
Skin: Not expected to be a primary route of exposure.
Eye: Not expected to be a primary route of exposure..

Symptoms related to the physical, chemical, and toxicological characteristics:
Not expected to be a health hazard when used under normal conditions. An aspiration hazard is only valid if the oil is vaporized under pressure.

Delayed and immediate effects and chronic effects from short or long-term exposure:
Detailed below.

Numerical measures of toxicity:

Ingredient Information:

Substance	Test Type (species)	Value
Distillates (petroleum), solvent- dewaxed heavy paraffinic	LD_{50} Oral (Rat)	>5000 mg/kg
	LD_{50} Dermal (Rabbit)	>5000 mg/kg
	LC_{50} Inhalation (Rat)	>5 mg/l (4h)
Distillates (petroleum), hydro treated - heavy paraffinic	LD_{50} Oral (Rat)	>5000 mg/kg
	LD_{50} Dermal (Rabbit)	>5000 mg/kg
	LC_{50} Inhalation (Rat)	> 4 mg/l (4h)
Paraffin oils (petroleum), catalytic - dewaxed light	LD_{50} Oral (Rat)	>5000 mg/kg
	LD_{50} Dermal (Rabbit)	>2000 mg/kg
	LC_{50} Inhalation (Rat)	2.18 mg/L air (4h)
Additive	LD_{50} Oral (Rat)	No data available
	LD_{50} Dermal (Rabbit)	No data available
	LC_{50} Inhalation (Rat)	No data available

Product Acute Toxicity Estimates:

Acute Oral Toxicity (rat)

Product: >5000 mg/kg (estimate based on components)
Acute Dermal Toxicity (rabbit)
Product: No data available
Acute Inhalation Toxicity
Product: No data available.

Skin corrosion/irritation: Based upon information available on the known components, the product is not expected to cause skin irritation.

Serious eye damage/eye irritation: Based upon information available on the known components, the product is not expected to cause eye damage or eye irritation.

Respiratory sensitization: Based upon information available on the known components, the product is not expected to cause respiratory sensitization.

Skin sensitization: Based upon information available on the known components, the product is not expected to cause skin sensitization.

Germ cell mutagenicity: Based upon information available on the known components, the product is not anticipated to be a mutagen.

Carcinogenicity: No information available on the mixture, however none of the components are listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest edition), or by OSHA.

Reproductive toxicity: Based upon information available on the known components, the product is not anticipated to cause reproductive toxicity**.**

Specific target organ toxicity-
Single exposure: Based upon information available on the known components, the product is not anticipated to cause specific target organ toxicity after single exposure.

Specific target organ toxicity-
Repeat exposure: Based upon information available on the known components, the product is not anticipated to cause specific target organ toxicity after repeated or prolonged exposure.

Aspiration hazard: Based upon information available on the known components, this product is not expected to be a health hazard when used under normal conditions. An aspiration hazard may occur if the oil is vaporized under pressure.

Further information: No data available

SECTION 12: Ecological information

Ecotoxicity:

Product data:
No data available

Ingredient Information:

Substance	Test Type	Species	Value
Distillates (petroleum), solvent- dewaxed heavy paraffinic	LL/EL/IL50 NOEC/NOEL	Fish	Practically non toxic: LL/EL/IL50 > 100 mg/l NOEC/NOEL > 100 mg/l (based on test data)
	LL/EL/IL50 NOEC/NOEL	Invertebrate	Practically non toxic: LL/EL/IL50 > 100 mg/l NOEC/NOEL expected to be > 1.0 - <= 10 mg/l (based on test data)
	LL/EL/IL50	Algae	Practically non toxic: LL/EL/IL50 > 100 mg/l
Distillates (petroleum), hydro treated - heavy paraffinic	NOEC	Fish Pimephales promelas	NOEC--> 1000 mg/l (7d)
	NOEC	Invertebrate Daphnia magna	NOEC--> 1000 mg/l (21d)
	EC_{50}	Algae	EC50--> 1000 mg/l (96h)
Paraffin oils (petroleum), catalytic - dewaxed light	NOELR LL50	Fish	NOELR >= 1000 mg/L (14d) LL50 > 100 mg/L (96h)
	NOEL LL50	Invertebrate	NOEL 10mg/L (21d) LL50 > 10000 mg/L (24h)
	NOEL	Algae	NOEL >= 100 mg/L (72h)
Additive	LC_{50}	Fish	No data available

	EC_{50}	Invertebrate	No data available
	LC_{50}	Algae	No data available

Persistence and degradability: Major constituents are expected to be readily biodegradable, but the product contains components that may persist in the environment.

Bioaccumulative potential: Contains components with the potential to bioaccumulate.

Mobility in soil: If it enters soil, it will adsorb to soil particles and will not be mobile.

Mobility in general: Liquid under most environmental conditions. Floats on water.

Other adverse effects: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

SECTION 13: Disposal considerations

Disposal instructions:
Recover or recycle if possible. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with all applicable Federal, State and local regulations. Do not dispose into the environment, in drains or in water courses.

SECTION 14: Transport Information

Land Transport DOT: Not regulated.
Air Transport IATA: Not regulated.
Sea Transport IMDG: Not regulated.

SECTION 15: Regulatory Information

USA:

United States Federal Regulations: This SDS complies with the OSHA, 29 CFR 1910.1200. The product is not hazardous under OSHA.

Toxic Substances Control Act (TSCA) – All substances in this product are listed, as required, on the TSCA inventory.

SARA Superfund and Reauthorization Act of 1986 Title III sections 302, 311,312 and 313:
Section 302 – No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

CERCLA Hazardous Substance List, 40 CFR 302.4: This product contains chemicals listed on CERCLA. Zinc Compounds (<1 %)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3): None

SARA Title III
Section 302 Extremely Hazardous Substance (40 CFR 355, Appendix A): None

Section 311/312 (40 CFR 370):
Immediate Hazard: No
Delayed Hazard: No
Fire Hazard: No
Pressure Hazard: No
Reactivity Hazard: No

Section 313 Toxic Release Inventory (40 CFR 372):
None

STATE REGULATIONS:

This SDS contains specific health and safety data is applicable for state requirements. For details on your regulatory requirements you should contact the appropriate agency in your state.

California Proposition 65 (California Safe Drinking Water and Toxic Enforcement Act of 1986: None known.

Massachusetts Right to Know: Oil Mist, mineral; Petroleum paraffin oils, catalytic dewaxed light are listed on the Massachusetts Right to Know list.

Minnesota Hazardous Substance List: None of the components are listed on the Minnesota HSL.

New Jersey Right to Know: None of the components are listed on the New Jersey Right to Know list.

Pennsylvania Right to Know: None of the components are listed on the Pennsylvania Right to Know list.

SECTION 16: Other Information

Revision Date: July 13, 2016

To the best of our knowledge, the information contained herein is accurate. However SPX Hydraulic Technologies does not assume any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist.

Safety Data Sheet
Isopropyl Rubbing Alcohol USP 70%

SDS Revision Date: 01/09/2018

1. Identification

1.1. Product identifier

Product Identity	Isopropyl Rubbing Alcohol USP 70%
Alternate Names	Product Code: 002

1.2. Relevant identified uses of the substance or mixture and uses advised against

Intended use	First aid to help prevent the risk of infection in: minor cuts, scrapes, burns. For external use only.
Application Method	Clean the affected area. Apply 1 to 3 times daily.

1.3. Details of the supplier of the safety data sheet

Company Name	Hydrox Laboratories 825 Tollgate Rd. Elgin, IL 60123
Emergency	
24 hour Emergency Telephone No.	800-255-3924
Customer Service: Hydrox Laboratories	847-468-9400

2. Hazard(s) identification

2.1. Classification of the substance or mixture

Flam. Liq. 3;H226	Flammable liquid and vapor.
Eye Irrit. 2;H319	Causes serious eye irritation.
STOT SE 3;H336	May cause drowsiness or dizziness.

2.2. Label elements

Using the Toxicity Data listed in section 11 and 12 the product is labeled as follows.

(Not required on OTC product or case labels per Occupational Safety and Health Standards 29 CFR 1910.1200(b)(5))

Warning

H226 Flammable liquid and vapor.
H319 Causes serious eye irritation.
H336 May cause drowsiness and dizziness.

[Prevention]:

P210 Keep away from heat / sparks / open flames / hot surfaces - No smoking.

P235 Keep cool.

P240 Ground / bond container and receiving equipment.

P241 Use explosion-proof electrical / ventilating / light / equipment.

P242 Use only non-sparking tools.

P243 Take precautionary measures against static discharge.

P261 Avoid breathing dust / fume / gas / mist / vapors / spray.

P264 Wash thoroughly after handling.

P271 Use only outdoors or in a well-ventilated area.

P280 Wear protective gloves / eye protection / face protection.

[Response]:

P303+361+353 IF ON SKIN (or hair): Remove / Take off immediately all contaminated clothing. Rinse skin with water / shower.

P304+312 IF INHALED: Call a POISON CENTER or doctor / physician if you feel unwell.

P305+351+338 IF IN EYES: Rinse continuously with water for several minutes. Remove contact lenses if present and easy to do - continue rinsing.

P337+313 If eye irritation persists: Get medical advice / attention.

P340 Remove victim to fresh air and keep at rest in a position comfortable for breathing.

P370+378 In case of fire: Use extinguishing media listed in section 5 of SDS for extinction.

[Storage]:

P403+233 Store in a well ventilated place. Keep container tightly closed.

P405 Store locked up.

[Disposal]:

P501 Dispose of contents / container in accordance with local / national regulations.

3. Composition/information on ingredients

This product contains the following substances that present a hazard within the meaning of the relevant State and Federal Hazardous Substances regulations.

Ingredient/Chemical Designations	Weight %	GHS Classification	Notes
Isopropyl Alcohol **CAS Number: 0000067-63-0**	**50 - 75**	**Flam. Liq. 2;H225** **Eye Irrit. 2;H319** **STOT SE 3;H336**	**[1][2]**

[1] Substance classified with a health or environmental hazard.
[2] Substance with a workplace exposure limit.
[3] PBT-substance or vPvB-substance.
*The full texts of the phrases are shown in Section 16.

4. First aid measures

4.1. Description of first aid measures

General In all cases of doubt, or when symptoms persist, seek medical attention.
Never give anything by mouth to an unconscious person.

Inhalation Remove to fresh air, keep patient warm and at rest. If breathing is irregular or stopped, give artificial respiration. If unconscious place in the recovery position and obtain immediate medical attention. Give nothing by mouth.

Eyes	Irrigate copiously with clean water for at least 15 minutes, holding the eyelids apart and seek medical attention.
Skin	Remove contaminated clothing. Wash skin thoroughly with soap and water or use a recognized skin cleanser.
Ingestion	If swallowed obtain immediate medical attention. Keep at rest. Do NOT induce vomiting.

4.2. Most important symptoms and effects, both acute and delayed

Overview Signs and Symptoms of Exposure: Giddiness, headache, dizziness and nausea.

Medical Conditions Generally Aggravated by Exposure: Pre-existing and respiratory disorders, may be aggravated by exposure.

Health Hazards (Acute and Chronic): Generally used as a rubdown. Vapor irritates eyes. High concentration of vapor can irritate respiratory tract, is anesthetic and may cause CNS depression.

Not a carcinogen.

Exposure to solvent vapor concentrations from the component solvents in excess of the stated occupational exposure limits may result in adverse health effects such as mucous membrane and respiratory system irritation and adverse effects on the kidneys, liver and central nervous system. Symptoms include headache, nausea, dizziness, fatigue, muscular weakness, drowsiness and in extreme cases, loss of consciousness.

Repeated or prolonged contact with the preparation may cause removal of natural fat from the skin resulting in dryness, irritation and possible non-allergic contact dermatitis. Solvents may also be absorbed through the skin. Splashes of liquid in the eyes may cause irritation and soreness with possible reversible damage. See section 2 for further details.

Inhalation	May cause drowsiness or dizziness.
Eyes	Causes serious eye irritation.

5. Fire-fighting measures

5.1. Extinguishing media

Recommended extinguishing media; alcohol resistant foam, CO_2, water fog.
Do not use; water jet.

5.2. Special hazards arising from the substance or mixture

Hazardous decomposition: Burning may produce carbon monoxide and carbon dioxide contamination.

Keep away from heat / sparks / open flames / hot surfaces - No smoking.

Avoid breathing dust / fume / gas / mist / vapors / spray.

5.3. Advice for fire-fighters

Dilution of burning liquid with water will affect extinguishment.

None

ERG Guide No. ----

6. Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Put on appropriate personal protective equipment (see section 8).

6.2. Environmental precautions

Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

6.3. Methods and material for containment and cleaning up

Eliminate all sources of ignition. Small spills should be flushed with large quantities of water, larger spills should be collected for disposal.

Atomize into an incinerator where permitted under appropriate federal, state, and local regulations.

7. Handling and storage

7.1. Precautions for safe handling

Do NOT take internally. Flammable liquid. Keep away from heat, sparks and open flames. Keep container closed.

See section 2 for further details. - [Prevention]:

7.2. Conditions for safe storage, including any incompatibilities

Handle containers carefully to prevent damage and spillage.

Naked flames and smoking should not be permitted in storage areas. It is recommended that fork lift trucks and electrical equipment are protected to the appropriate standard.

Incompatible materials: Anyhydride, isocyanate, monomer and organo-metallic.

See section 2 for further details. - [Storage]:

7.3. Specific end use(s)

No data available.

8. Exposure controls and personal protection

8.1. Control parameters

Exposure

CAS No.	Ingredient	Source	Value
0000067-63-0	Isopropyl Alcohol	OSHA	TWA 400 ppm (980 mg/m3)STEL 500 ppm
		ACGIH	TWA: 200 ppm STEL: 400 ppm Revised 2003,
		NIOSH	TWA 400 ppm (980 mg/m3) ST 500 ppm (1225 mg/m3)
		Supplier	No Established Limit

Carcinogen Data

CAS No.	Ingredient	Source	Value
0000067-63-0	Isopropyl Alcohol	OSHA	Select Carcinogen: No
		NTP	Known: No; Suspected: No
		IARC	Group 1: No; Group 2a: No; Group 2b: No; Group 3: Yes; Group 4: No;

8.2. Exposure controls

Respiratory If workers are exposed to concentrations above the exposure limit they must use the appropriate, certified respirators.

Eyes Protective goggles if desired.

Skin Rubber or vinyl gloves if desired.

Engineering Controls Provide adequate ventilation. Where reasonably practicable this should be achieved by the use of local exhaust ventilation and good general extraction. If these are not sufficient to maintain concentrations of particulates and any vapor below occupational exposure limits suitable respiratory protection must be worn.

Other Work Practices Ensure showers and eyewash stations are available. Use good personal hygiene practices. Wash hands before eating, drinking, smoking or using toilet. Promptly remove soiled clothing and wash thoroughly before reuse.

See section 2 for further details. - [Prevention]:

9. Physical and chemical properties

Appearance	Colorless Liquid
Odor	Characteristic
Odor threshold	Not Measured
pH	Not Measured
Melting point / freezing point	Not Measured
Initial boiling point and boiling range	87C
Flash Point	77F (TCC)
Evaporation rate (Ether = 1)	2.3 (Butyl Acetate=1)
Flammability (solid, gas)	Not Applicable
Upper/lower flammability or explosive limits	**Lower Explosive Limit:** 2 **Upper Explosive Limit:** 12
Vapor pressure (Pa)	33 mmHg
Vapor Density	2.07 (Air=1)
Specific Gravity	0.88 (H2O=1) @ 25 C
Solubility in Water	Complete
Partition coefficient n-octanol/water (Log Kow)	Not Measured
Auto-ignition temperature	Not Measured
Decomposition temperature	Not Measured
Viscosity (cSt)	Not Measured
% Volatile	100

Isopropyl Alcohol Assay by Volume 68%-72%

9.2. Other information

No other relevant information.

10. Stability and reactivity

10.1. Reactivity

Hazardous Polymerization will not occur.

10.2. Chemical stability

Stable under normal circumstances.

10.3. Possibility of hazardous reactions

No data available.

10.4. Conditions to avoid

Avoid heat, sparks and open flame.

10.5. Incompatible materials

Anyhydride, isocyanate, monomer and organo-metallic.

10.6. Hazardous decomposition products

Burning may produce carbon monoxide and carbon dioxide contamination.

11. Toxicological information

Acute toxicity

Repeated or prolonged contact with the preparation may cause removal of natural fat from the skin resulting in dryness, irritation and possible non-allergic contact dermatitis. Solvents may also be absorbed through the skin. Splashes of liquid in the eyes may cause irritation and soreness with possible reversible damage.

Ingredient	Oral LD50, mg/kg	Skin LD50, mg/kg	Inhalation Vapor LD50, mg/L/4hr	Inhalation Dust/Mist LD50, mg/L/4hr	Inhalation Gas LD50, ppm
Isopropyl Alcohol - (67-63-0)	4,710.00, Rat - Category: 5	12,800.00, Rat - Category: NA	72.60, Rat - Category: NA	No data available	No data available

Note: When no route specific LD50 data is available for an acute toxin, the converted acute toxicity point estimate was used in the calculation of the product's ATE (Acute Toxicity Estimate).

Classification	Category	Hazard Description
Acute toxicity (oral)	---	Not Applicable
Acute toxicity (dermal)	---	Not Applicable
Acute toxicity (inhalation)	---	Not Applicable
Skin corrosion/irritation	---	Not Applicable
Serious eye damage/irritation	2	Causes serious eye irritation.
Respiratory sensitization	---	Not Applicable

Skin sensitization	---	Not Applicable
Germ cell mutagenicity	---	Not Applicable
Carcinogenicity	---	Not Applicable
Reproductive toxicity	---	Not Applicable
STOT-single exposure	3	May cause drowsiness or dizziness.
STOT-repeated exposure	---	Not Applicable
Aspiration hazard	---	Not Applicable

12. Ecological information

12.1. Toxicity

The preparation has been assessed following the conventional method of the Dangerous Preparations Directive 1999/45/EC and GHS and is not classified as dangerous for the environment, but contains substance(s) dangerous for the environment. See section 3 for details

Aquatic Ecotoxicity

Ingredient	96 hr LC50 fish, mg/l	48 hr EC50 crustacea, mg/l	ErC50 algae, mg/l
Isopropyl Alcohol - (67-63-0)	1,400.00, Lepomis macrochirus	100.00, Daphnia magna	100.00 (72 hr), Scenedesmus subspicatus

12.2. Persistence and degradability

There is no data available on the preparation itself.

12.3. Bioaccumulative potential

Not Measured

12.4. Mobility in soil

No data available.

12.5. Results of PBT and vPvB assessment

This product contains no PBT/vPvB chemicals.

12.6. Other adverse effects

No data available.

13. Disposal considerations

13.1. Waste treatment methods

Observe all federal, state and local regulations when disposing of this substance.

14. Transport information

UN Number	1219
UN Proper Shipping Name	Isopropanol, 3
DOT Classification	Hazmat at all levels depending on size of packaging, Excepted or Limited Quantity or Fully Regulated

Packaging Group	PGII
Additional Information	IATA OR IMDG – UN1219, Isopropanol, 3, PG II

15. Regulatory information

Regulatory Overview	The regulatory data in Section 15 is not intended to be all-inclusive, only selected regulations are represented.
Toxic Substance Control Act (TSCA)	All components of this material are either listed or exempt from listing on the TSCA Inventory.
WHMIS Classification	B2 D2B

US EPA Tier II Hazards

Fire: Yes
Sudden Release of Pressure: No
Reactive: No
Immediate (Acute): Yes
Delayed (Chronic): No

EPCRA 311/312 Chemicals and RQs:
No chemicals at levels which require reporting under this statute.

EPCRA 302 Extremely Hazardous:
No chemicals at levels which require reporting under this statute.

EPCRA 313 Toxic Chemicals:

Isopropyl Alcohol

Proposition 65 - Carcinogens (>0.0%):
No chemicals at levels which require reporting under this statute.

Proposition 65 - Developmental Toxins (>0.0%):
No chemicals at levels which require reporting under this statute.

Proposition 65 - Female Repro Toxins (>0.0%):
No chemicals at levels which require reporting under this statute.

Proposition 65 - Male Repro Toxins (>0.0%):
No chemicals at levels which require reporting under this statute.

New Jersey RTK Substances (>1%):

Isopropyl Alcohol

Pennsylvania RTK Substances (>1%):

Isopropyl Alcohol

16. Other information

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein. We accept no responsibility and disclaim all liability for any harmful effects which may be caused by exposure to our products. Customers/users of this product must comply with all applicable health and safety laws, regulations, and orders.

The full text of the phrases appearing in section 3 is:

H225 Highly flammable liquid and vapor.

H319 Causes serious eye irritation.

H336 May cause drowsiness and dizziness.

This is the first version in the GHS SDS format. Listings of changes from previous versions in other formats are not applicable.

Disclaimer: The contents of this MSDS are believed to be correct but do not purport to be all-inclusive and should only be used as a guide. Hydrox Laboratories, Inc. disclaims any express or implied warranty as to the accuracy of the above information and shall not be held liable for any direct, incidental or consequential damages resulting from the reliance on the above information.

End of Document

Safety Data Sheet
acc. to OSHA GHS (29 CFR 1910.1200)

Printing date 12/23/2015 Reviewed on 12/23/2015

1 Identification

· **Product identifier**

· **Trade name: Solar Flux® Type B**

· **Other means of identification:**
· **SDS Number:** 0082

· **Recommended use and restriction on use**
· **Recommended use:** Powder flux for welding
· **Restrictions on use:** No relevant information available.

· **Manufacturer/Importer/Supplier/Distributor information**
· **Manufacturer/Supplier:**
Harris Products Group
4501 Quality Place
Mason, Ohio 45040 US
513-754-2000

· **Safety Data Sheet Questions:** salesinfo@jwharris.com
· **Arc Welding Safety Information:** www.lincolnelectric.com/safety

· **24-Hour Emergency Response Telephone Numbers:**
1-866-519-4752 (USA, Canada, Mexico only)

(+) 1-760-476-3962

· **3E Company Access Code:** 333895

2 Hazard(s) identification

Classified according to the criteria of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), OSHA Hazard Communication Standard (29 CFR 1910.1200) and the Canadian Controlled Products Regulations.

· **Classification of the substance or mixture**

GHS08 Health hazard

Carc. 1A H350 May cause cancer.
· **Additional information:**
There are no other hazards not otherwise classified that have been identified.
0 % of the mixture consists of component(s) of unknown toxicity.

· **Label elements**
· **GHS label elements**
The product is classified and labeled according to the Globally Harmonized System (GHS).

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· **Hazard pictograms:**

GHS08

· **Signal word:** Danger

· **Hazard-determining components of labeling:**
Quartz (SiO2)
· **Hazard statements:**
H350 May cause cancer.
· **Precautionary statements:**
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P280 Wear protective gloves/protective clothing/eye protection.
P308+P313 IF exposed or concerned: Get medical advice/attention.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
· **Additional information:**
· **Other hazards which do not result in GHS classification:**
Electrical Shock can kill. If welding must be performed in damp locations or with wet clothing, on metal structures or when in cramped positions such as sitting, kneeling or lying, or if there is a high risk of unavoidable or accidental contact with workpiece, use the following equipment: Semiautomatic DC Welder, DC Manual (Stick) Welder, or AC Welder with Reduced Voltage Control.

Arc rays can injure eyes and burn skin. Welding arc and sparks can ignite combustibles and flammable materials. Overexposure to welding fumes and gases can be hazardous. Read and understand the manufacturer's instructions, Safety Data Sheets and the precautionary labels before using this product. Refer to Section 8.

3 Composition/information on ingredients

· **Chemical characterization: Mixtures**

· **Dangerous components:**		
14808-60-7	Quartz (SiO2)	6-12%

· **Additional information:**
For the listed ingredient(s), the identity and exact percentage(s) are being withheld as a trade secret.

4 First-aid measures

· **Description of first aid measures**
· **General information:** Provide oxygen treatment if affected person has difficulty breathing.

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· **After inhalation:**
Move to fresh air if breathing is difficult. If breathing has stopped, perform artificial respiration and obtain medical assistance at once.
· **After skin contact:**
Remove contaminated clothing and wash the skin thoroughly with soap and water. For reddened or blistered skin, or thermal burns, obtain medical assistance at once.
· **After eye contact:**
Dust or fume from this product should be flushed from the eyes with copious amounts of clean, tepid water until transported to an emergency medical facility. Do not allow victim to rub or keep eyes tightly closed. Obtain medical assistance at once.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; immediately call for medical help.
· **Most important symptoms and effects, both acute and delayed:**
Nausea
Gastric or intestinal disorders when ingested.
Breathing difficulty
Coughing
· **Danger:**
Carcinogenic.
Welding hazards are complex and may include physical and health hazards such as but not limited to electric shock, physical strains, radiation burns (eye flash), thermal burns due to hot metal or spatter and potential health effects of overexposure to welding fume or dust. Refer to Section 11 for more information.
· **Indication of any immediate medical attention and special treatment needed:** Treat symptomatically.

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:**
As shipped, the product will not burn. In case of fire in the surroundings: use appropriate extinguishing agent.
For metal fires: Use specific agents only.
· **For safety reasons unsuitable extinguishing agents:** For metal fires: Use specific agents only.
· **Special hazards arising from the substance or mixture**
Infrared radiation from flame or hot metal can ignite combustibles and flammable products.
· **Advice for firefighters**
· **Special fire fighting procedures:**
Use standard firefighting procedures and consider the hazards of other involved materials.
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information:**
Read and understand American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" and National Fire Protection Association NFPA 51B, "Standard for Fire Prevention During Welding, Cutting and Other Hot Work" before using this product.

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6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures:**
If airborne dust and/or fume is present, use adequate engineering controls and, if needed, personal protection to prevent overexposure. Refer to recommendations in Section 8.
· **Environmental precautions:**
Avoid release to the environment.
Damp down dust with water spray.
Prevent further leakage or spillage if safe to do so.
· **Methods and material for containment and cleaning up:**
Clean up spills immediately, observing precautions in the personal protective equipment in Section 8.
Avoid generating dust. Prevent product from entering any drains, sewers or water sources.
Pick up mechanically.
Send for recovery or disposal in suitable receptacles.
· **Reference to other sections:**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

· **Handling**
· **Precautions for safe handling:**
Avoid breathing dust.
Ensure good ventilation/exhaustion at the workplace.
Any deposit of dust which cannot be avoided must be regularly removed.
Prevent formation of dust. Ensure good ventilation/exhaustion at the workplace. Any deposit of dust which cannot be avoided must be regularly removed. Read and understand the manufacturer's instruction and the precautionary label on the product. Refer to Lincoln Safety Publications at www.lincolnelectric.com/safety. See American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" published by the American Welding Society, http:// pubs.aws.org and OSHA Publication 2206 (29CFR1910), U.S. Government Printing Office, www.gpo.gov.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage**
· **Requirements to be met by storerooms and receptacles:**
Store in closed original container in a dry place. Store away from incompatible materials. Store in accordance with local/regional/national regulations.
· **Information about storage in one common storage facility:** No special requirements.
· **Further information about storage conditions:** No special requirements.
· **Specific end use(s):** No relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:** No further data; see item 7.

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· **Control parameters**
· **Exposure Guidelines:**
Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) are values published by the American Conference of Government Industrial Hygienists (ACGIH). ACGIH Statement of Positions Regarding the TLVs® and BEIs® states that the TLV-TWA should be used as a guide in the control of health hazards and should not be used to indicate a fine line between safe and dangerous exposures. See Sections 2, 3, 8, 10, and 11 for information on potential fume constituents of health interest. Threshold Limit Values are figures published by the American Conference of Government Industrial Hygienists.

· **Components with limit values that require monitoring at the workplace:**	
14808-60-7 Quartz (SiO2)	
PEL (USA)	see Quartz listing
REL (USA)	Long-term value: 0.05* mg/m³ *respirable dust; See Pocket Guide App. A
TLV (USA)	Long-term value: 0.025* mg/m³ *as respirable fraction
EL (Canada)	Long-term value: 0.025 mg/m³ ACGIH A2; IARC 1
EV (Canada)	Long-term value: 0.10* mg/m³ *respirable fraction
LMPE (Mexico)	Long-term value: 0.025* mg/m³ A2, *fracción respirable

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
Determine the composition and quantity of fumes and gases to which workers are exposed by taking an air sample from inside the welder's helmet if worn or in the worker's breathing zone. Improve ventilation if exposures are not below limits. See ANSI/AWS F1.1, F1.2, F1.3 and F1.5, available from the American Welding Society, www.aws.org.
Keep away from foodstuffs, beverages and feed.
· **Engineering controls:** No relevant information available.
· **Ventilation**
Use enough ventilation, local exhaust at the arc, or both to keep the fumes and gases from the worker's breathing zone and the general area. Train the welder to keep his head out of the fumes . Keep exposure as low as possible.
· **Breathing equipment:**
Particulate mask should filter at least 99% of airborne particles.
Keep your head out of fumes. Use enough ventilation and local exhaust to keep fumes and gases from your breathing zone and the general area. An approved respirator should be used unless exposure assessments are below applicable exposure limits.
· **Protection of hands:**

Thermally-protective gloves.

Suitable gloves can be recommended by the glove supplier.

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The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.

· **Eye protection:**

Wear helmet or use face shield with filter lens shade number 12 or darker for open arc processes. No specific lens shade recommendation for submerged arc processes. Shield others by providing screens and flash goggles.

· **Body protection:** Protective work clothing
· **Limitation and supervision of exposure into the environment** No special requirements.
· **Risk management measures** No special requirements.

9 Physical and chemical properties

· **Information on basic physical and chemical properties**	
· **General information**	
· **Appearance:**	
Form:	Powder
Color:	Silver-colored
· **Odor:**	Odorless
· **Odor threshold:**	Not determined.
· **pH-value:**	Not applicable.
· **Change in condition:**	
Melting point/Melting range:	Not determined.
Boiling point/Boiling range:	1682 °C (3060 °F)
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not determined.
· **Auto-ignition temperature:**	Not determined.
· **Decomposition temperature:**	Not determined.
· **Auto igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapor pressure:**	Not applicable.
· **Density:**	2.2 g/cm³ (18.359 lbs/gal)
· **Relative density:**	Not determined.
· **Vapor density:**	Not applicable.
· **Evaporation rate:**	Not applicable.
· **Solubility in / Miscibility with:**	
Water:	Partly soluble.

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· **Partition coefficient (n-octanol/water):** Not determined.

· **Viscosity:**
Dynamic: Not applicable.
Kinematic: Not applicable.
· **Other information** No relevant information available.

10 Stability and reactivity

· **Reactivity:** The product is non-reactive under normal conditions of use, storage and transport.
· **Chemical stability:** Stable under normal temperatures and pressures.
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used and stored according to specifications.
· **Possibility of hazardous reactions:**
Reacts with strong acids and alkali.
Reacts with strong oxidizing agents.
As the product is supplied it is not capable of dust explosion; however enrichment with fine dust causes risk of dust explosion.
· **Conditions to avoid:** Prevent formation of dust.
· **Incompatible materials:** No relevant information available.
· **Hazardous decomposition products:**
Hazardous decomposition welding fumes and gases cannot be classified simply. The composition and products: quantity of both are dependent upon the metal being welded, the process, procedure and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating, or galvanizing), the number of welders and the volume of the worker area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities.)

11 Toxicological information

· **Information on likely routes of exposure**
· **Ingestion:** Possible route of exposure.
· **Inhalation:**
Potential chronic health hazards related to the use of welding consumables are most applicable to the inhalation route of exposure.
· **Skin Contact:** Arc rays can burn skin. Skin cancer has been reported.
· **Eye Contact:** Arc rays can injure eyes.
· **Information on toxicological effects**
· **Inhalation**
Short-term (acute) overexposure to welding fumes may result in discomfort such as metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes. May aggravate pre-existing respiratory problems (e.g. asthma, emphysema). Long-term (chronic) overexposure to welding fumes can lead to siderosis (iron deposits in lung), central nervous system effects, bronchitis and other pulmonary effects.

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· **Acute toxicity:**
· **LD/LC50 values that are relevant for classification:** None.
· **Primary irritant effect:**
· **On the skin:** Based on available data, the classification criteria are not met.
· **On the eye:** Based on available data, the classification criteria are not met.
· **Sensitization:** No sensitizing effects known.

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer):**		
14808-60-7	Quartz (SiO2)	1

· **NTP (National Toxicology Program):**		
14808-60-7	Quartz (SiO2)	K

· **OSHA-Ca (Occupational Safety & Health Administration):**
None of the ingredients are listed.

· **Other information relevant to carcinogenicity**
Cancerous lesions have been reported in persons exposed to arc rays.
· **Repeated dose toxicity:**
Repeated or long-term inhalation of product dusts may cause pulmonary disease.
· **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**
Carc. 1A
· **Germ cell mutagenicity:** Based on available data, the classification criteria are not met.
· **Carcinogenicity:** May cause cancer.
· **Reproductive toxicity:** Based on available data, the classification criteria are not met.
· **STOT-single exposure:** Based on available data, the classification criteria are not met.
· **STOT-repeated exposure:** Based on available data, the classification criteria are not met.
· **Aspiration hazard:** Based on available data, the classification criteria are not met.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No relevant information available.
· **Persistence and degradability:** No relevant information available.
· **Behavior in environmental systems**
· **Bioaccumulative potential:** No relevant information available.
· **Mobility in soil:** No relevant information available.
· **Additional ecological information**
· **General notes:**
Due to available data on eliminability/decomposition and bioaccumulation potential, a prolonged damage of the environment is unlikely.
Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.

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· **Other adverse effects:** No relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:**
Contact waste processors for recycling information.
The user of this material has the responsibility to dispose of unused material, residues and containers in compliance with all relevant local, state and federal laws and regulations regarding treatment, storage and disposal for hazardous and nonhazardous wastes.

· **Uncleaned packagings**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number** · **DOT, ADR, IMDG, IATA**	Not regulated.
· **UN proper shipping name** · **DOT, ADR, IMDG, IATA**	Not regulated.
· **Transport hazard class(es)** · **DOT, ADR, IMDG, IATA** · **Class**	Not regulated.
· **Packing group** · **DOT, ADR, IMDG, IATA**	Not regulated.
· **Environmental hazards**	Not applicable.
· **Special precautions for user**	Not applicable.
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**

· **US Federal Regulations**

None of the ingredients are listed.

· **SARA**

· **Section 313 (TRI reporting)**

None of the ingredients are listed.

· **Section 355 (extremely hazardous substances):**

None of the ingredients are listed.

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· **CERCLA Hazardous Substance List (40 CFR 302.4):**

None of the ingredients are listed.

· **TSCA (Toxic Substances Control Act)**

All ingredients are listed.

· **Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)**
None present or none present in regulated quantities.

· **Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):**
None present or none present in regulated quantities.

· **Proposition 65 (California)**

· **Chemicals known to cause cancer:**

14808-60-7	Quartz (SiO2)

· **Chemicals known to cause reproductive toxicity for females:**

None of the ingredients are listed.

· **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients are listed.

· **Chemicals known to cause developmental toxicity:**

None of the ingredients are listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency):**

None of the ingredients are listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health):**

14808-60-7	Quartz (SiO2)

· **State Right to Know Listings**

· **US. New Jersey Worker and Community Right-to-Know Act**

Quartz (SiO2)

· **Canada**

· **Canadian substance listings**

· **Canadian Domestic Substances List (DSL):**

All ingredients are listed.

· **Canada Non-Domestic Substances List (NDSL)**

None of the ingredients are listed.

· **Canadian Ingredient Disclosure list (limit 0.1%):**

None of the ingredients are listed.

· **Canadian Ingredient Disclosure list (limit 1%):**

14808-60-7	Quartz (SiO2)

· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

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Printing date 12/23/2015 Reviewed on 12/23/2015

Trade name: Solar Flux® Type B

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16 Other information

· **Date of preparation / last revision** 12/23/2015 / -

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
DNEL: Derived No-Effect Level (REACH)
PNEC: Predicted No-Effect Concentration (REACH)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
OSHA: Occupational Safety & Health
Carc. 1A: Carcinogenicity, Hazard Category 1A

· **Sources**
Website, European Chemicals Agency (http://http://echa.europa.eu/)
Website, US EPA Substance Registry Services (http://http://ofmpub.epa.gov/sor_internet/registry/substreg/home/overview/home.do)
Website, Chemical Abstracts Registry, American Chemical Society (https://www.cas.org)
Patty's Industrial Hygiene, 6th ed., Rose, Vernon, ed. ISBN: ISBN: 978-0-470-07488-6
Casarett and Doull's Toxicology: The Basic Science of Poisons, 8th Ed., Klaasen, Curtis D., ed., ISBN: 978-0-07-176923-5.
Safety Data Sheets, Individual Manufacturers

SDS Prepared by:
ChemTel Inc.
1305 North Florida Avenue
Tampa, Florida USA 33602-2902
Toll Free North America 1-888-255-3924 Intl. +01 813-248-0573
Website: www.chemtelinc.com

· **Disclaimer:**
We urge each end user and recipient of this SDS to study it carefully. If necessary consult an industrial hygienist or other expert to understand this information and safeguard the environment and protect workers from potential hazards associated with the handling or use of this product.

Harris Products Group cannot anticipate all conditions under which this information and its product, or the products of other manufacturers in combination with its product, may be used. It is the user's responsibility to ensure safe conditions for use, handling, storage and disposal of the product, and to assume liability for loss, injury, damage or expense due to improper use. The information in the sheet was written based on the best knowledge and experience currently available.

Section 1 - Product and Company Identification

Product Identifiers:

Product name: **Spectracide Wasp & Hornet Killer$_3$**
EPA reg. number: 9688-190-8845
Recommended product use: Insecticide - Wasp & Hornet, Aerosol

Details of the Supplier of the Safety Data Sheet:

Manufacturer/Supplier: Chemsico
Div. of United Industries Corp.
P.O. Box 142642
St. Louis, MO 63114

For product information: 1-800-917-5438

For medical emergencies: 1-800-633-2873

Section 2 - Hazards Identification

Conforms to Hazard Communication Standard 29 CFR 1910.1200.

GHS Classification of Substance or Mixture: Flammable aerosol - Category 2

GHS Label Elements:

Hazard pictogram(s):

Signal word: WARNING

Hazard statements:
- Flammable aerosol
- Compressed gas – contents under pressure; may burst if heated

Precautionary Statements:
- Contents under pressure.
- Do not use or store near heat or open flame.
- Do not puncture or incinerate container.
- Exposure to temperatures above 130°F may cause bursting.

Section 3 - Composition / Information on Ingredients

Chemical Name	CAS#	Weight Percent
Lambda-cyhalothrin	91465-08-6	0.010%
Prallethrin	23031-36-9	0.025%
Isopropyl alcohol	67-63-0	2.000%
Petroleum distillates, hydrotreated light	64742-47-8	5.000%
Propane	74-98-6	3.500%

Note: Ingredients not identified are proprietary or non-hazardous. Values are not product specification(s).

Section 4 - First Aid Measures

Eye contact: No special requirements

Skin contact:	No special requirements
Inhalation:	No special requirements
Ingestion:	No special requirements
Note to Physician:	None
General advice:	If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Keep out of reach of children.

Section 5 - Fire Fighting Measures

Flammable properties:	Pressurized aerosol container
NFPA classification:	NFPA level 1 aerosol
Suitable extinguishing media:	Water fog, foam, CO_2, dry chemical
Unsuitable extinguishing media:	Not available
Specific hazards arising from the chemical:	Contents under pressure – container may burst in heat of fire.
Protective equipment for firefighters:	Firefighters should wear full protective clothing including self-contained breathing apparatus.
Hazardous combustion products:	None known
Explosion data:	Not available
Sensitivity to static discharge:	Not available
Personal precautions:	Keep unnecessary personnel away. Do not touch or walk through spilled material.

Section 6 - Accidental Release Measures

Personnel precautions:	Remove all sources of ignition. Wear personnel protective equipment as recommended in Section 8. Wash thoroughly after handling.
For emergency responders:	If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials.
Environmental precautions:	Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.
Methods for containment and cleaning up:	Stop leak if without risk. Move containers from spill area. Before attempting clean up, refer to hazard data given above. Small spills may be absorbed with earth, sand or absorbent material swept up and placed in suitable, covered, and labeled containers. Prevent large spills from entering sewers or waterways. Contact emergency services and supplier for advice. Never return spills in original containers for re-use.

Section 7 - Handling and Storage

Precautions for safe handling: Put on appropriate personal protective equipment as recommended in Section 8. Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50°C (122°F). Do not pierce or burn, even after use. Do not ingest. Avoid contact with skin, eyes and clothing. Avoid breathing vapor or mist. Use only with adequate ventilation. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous.

Storage: Store in a cool, dry area away from open flame. Do not store above 50°C (122°F).

Section 8 - Exposure Controls / Personal Protection

Exposure guidelines:

		Exposure Limits					
		OSHA PEL		ACGIH TLV		Supplier OEL	
Chemical name		**ppm**	**mg/m³**	**ppm**	**mg/m³**	**ppm**	**mg/m³**
Lambda-cyhalothrin	TWA	Not established		Not established		Not established	
Prallethrin	TWA	None		None		None	
Isopropyl alcohol	TWA	400	980	200	------	Not listed	
Petroleum distillates, light	TWA	None listed		------	200	None listed	
Propane	TWA	1000	1800	1000	------	Not established	

Engineering controls: General ventilation normally adequate.

Personal protective equipment:

Eye/Face protection: None required

Skin and body protection: None required

Respiratory protection: Where exposure guideline levels may be exceeded, use an approved NIOSH respirator.

General hygiene considerations: Handle in accordance with good industrial hygiene and safety practices. When using, do not eat or drink. Wash hands before breaks and immediately after handling the product.

Section 9 - Physical & Chemical Properties

Appearance: Clear

Color: Light yellow to water-white

Physical state: Pressurized liquid

Odor: Solvent, alcohol & pyrethroid

Odor threshold: No data available

pH: 7.2

Melting point:	No data available
Freezing point:	No data available
Boiling point:	No data available
Flash point:	No data available
Flame extension	0" (level 1 aerosol)
Flammability limits in air, lower, % by volume:	No data available
Flammability limits in air, upper, % by volume:	No data available
Vapor pressure:	No data available
Vapor density:	No data available
Relative density @ 20°C:	0.962
Octanol/water coefficient:	No data available
Auto-ignition temperature:	No data available
Decomposition temperature:	No data available
Solubility:	Miscible in water
Evaporation rate:	No data available
% Volatile organic compounds:	5.5

Section 10 - Chemical Stability & Reactivity Information

Reactivity

Conditions to avoid:	Do not mix with other chemicals.
Incompatible materials:	Avoid strong oxidizers.

Chemical stability

Product stability:	Stable under recommended storage conditions.

Other

Hazardous decomposition products:	None known
Possibility of hazardous reactions:	Hazardous polymerization does not occur.

Section 11 - Toxicological Information

Primary eye irritation:	Non-irritating (EPA tox. category IV)
Primary skin irritation:	Non-irritating (EPA tox. category IV)
Acute dermal:	LD_{50} > 2000 mg/kg (EPA tox. category III)
Acute inhalation:	LC_{50} > 2 mg/L (EPA tox. cateogry IV)
Acute oral:	LD_{50} > 5000 mg/kg (EPA tox. category IV)
Sensitization:	Not a skin sensitizer.
Chronic effects/ Carcinogenicity:	No data available
Mutagenicity:	No data available
Reproductive effects:	No data available

Teratogenicity:	No data available
Ecotoxicity:	No data available

Section 12 - Ecological Information

Environmental effects:	No data available
Aquatic toxicity:	Toxic to aquatic organisms.
Persistence / degradability:	No data available
Bioaccumulation / accumulation:	No data available
Partition coefficient:	No data available
Mobility in environmental media:	No data available
Chemical fate information:	No data available

Section 13 - Disposal Considerations

Waste codes:	Not available
Disposal instructions:	Dispose in accordance with all applicable regulations.
Waste from residues / unused products:	Not available
Contaminated packaging:	Not available

Section 14 - Transportation Information

U.S. Department of Transportation (DOT):	UN-1950, Aerosols, Flammable, 2.1, Limited Quantity
IATA:	UN-1950, Aerosols, 2.1
IMDG:	UN-1950, Aerosols, Flammable, 2, Limited Quantity

Section 15 - Regulatory Information

29 CFR 1910.1200 hazardous chemical Occupational Safety and Health Administration (OSHA):	No
CERCLA (Superfund) reportable quantity:	Not available

Hazard categories

Superfund Amendments and Reauthorization Act of 1986 (SARA):

Immediate Hazard	No
Delayed Hazard	No
Fire Hazard	No
Pressure Hazard	No
Reactivity Hazard	No

Section 302 extremely hazardous Substance:	No
Section 311 hazardous chemical:	No
Clean Air Act (CAA):	Not available

Clean Water Act (CWA): Not available

State regulations:

FIFRA labeling: This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets, and for workplace non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

Signal word: CAUTION

Precautionary statements: Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling.

This pesticide is toxic to fish. Do not apply directly to water.

Contents under pressure. Do not use or store near heat or open flame. Do not puncture or incinerate container. Exposure to temperatures above 130°F may cause bursting.

Notification status: All ingredients of this product are listed or are excluded from listing on the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

California Prop. 65: This product does not contain any chemicals known to the state of California to cause cancer, birth defects or any other reproductive harm.

Disclaimer: Information contained herein was obtained from sources considered technically accurate and reliable. While every effort has been made to ensure full disclosure of product hazards, in some cases data is not available and is so stated. Since conditions of actual product use are beyond control of the supplier, it is assumed that users of this material have been fully trained according to the requirements of all applicable legislation and regulatory instruments. No warranty, expressed or implied, is made and supplier will not be liable for any losses, injuries or consequential damages which may result from the use of or reliance on any information contained in this document.

Section 16 - Other Information

HMIS ratings: Health Hazard 1 Flammability 2 Physical Hazard 1

Item numbers: HG-95715

Formula number(s): 21-1437

Issue date: 2/29/2016

Prepared by:
Spectrum Group
Division of United Industries Corp.
P.O. Box 142642
St. Louis, MO 63114-0642
(800) 242-1166

UNITED ABRASIVES, INC.

SAFETY DATA SHEET

Resinoid Bonded Abrasives
For Cutting and Grinding Metals
SDS #1

1. IDENTIFICATION

Product Identity / Trade Name: Grinding and Cutting Wheels, Resinoid (Type 1, Type 27, Type 28, Type 29), Cup Wheels (Type 11) Cones and Plugs (Type 16, Type 17 and Type 18) Mounted Point.

Product Use: Abrasive materials used for cutting and grinding metals.
Restriction on Use: Use only as directed

Manufacturer: United Abrasives, Inc.
185 Boston Post Road
North Windham, CT 06256

Internet: www.unitedabrasives.com

Information Phone: (860) 456-7131 **Emergency Phone**: (860) 456-7131

Date of Preparation: February 15, 2017

2. HAZARD(S) IDENTIFICATION

Classification: This product is not classified as hazardous in accordance with the OSHA Hazard Communication Standard (29CFR 1910.1200).

Hazards not otherwise classified: Most of the dust/fumes generated in the cutting and grinding process is from the base material. The exposure to the dust/fumes from the material the potential hazard from this exposure must be evaluated.

Label Elements:
None required.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical name	CAS No.	Concentration
Aluminum Oxide	1344-28-1	0-95
Zirconium Oxide	1314-23-4	0-80
Cured Phenolic Resin	N/A	1-30
Nitrile Compounds	N/A	1-20
Fluoride Compounds	N/A	1-20
Iron Pyrite	12068-85-8	0-20
Woven Fiberglass	N/A	0-15
Calcium Compounds	N/A	0-15
Sulfur	7704-34-9	0-15
Calcium Oxide	1305-78-8	1-10

Cryolite	15096-52-3	1-10
Cured Epoxy Resin	N/A	1-10
Calcium Carbonate	1317-65-3	0-5
Iron Oxide	1309-37-1	0-5
Graphite	7782-42-5	0-5
Aluminum Potassium Fluoride	14484-69-6	0-0.5
Potassium Fluoroborate	14075-53-7	0.1-0.5
Titanium Dioxide	13463-67-7	0.1-0.5

The specific identity and/or exact percentage has been withheld as a trade secret.

4. FIRST-AID MEASURES

Ingestion: If grinding dust is swallowed, seek medical attention.
Inhalation: If overexposed to grinding dust, remove victim to fresh air and get medical attention.
Eye Contact: Flush eyes thoroughly with water, holding open eyelids. Get medical attention if irritation persists. Obtain immediate medical attention for foreign body in the eye.
Skin Contact: Wash dust from skin with soap and water. Launder contaminated clothing before reuse.

Most important symptoms/effects, acute and delayed: May cause mechanical eye and skin irritation. Inhalation of dust may cause nose, throat and upper respiratory tract irritation. Prolonged inhalation of high concentration of dust may cause adverse effects on the lungs. Prolonged overexposure may cause damage to the respiratory tract, bones and teeth by inhalation.

Indication of immediate medical attention and special treatment, if necessary: Immediate medical attention is not required.

5. FIRE-FIGHTING MEASURES

Suitable (and unsuitable) extinguishing media: Use any media that is appropriate for the surrounding fire.

Specific hazards arising from the chemical: This product is not combustible, however, consideration must be given to the potential fire or explosion hazards from the base material being processed. Many materials create flammable or explosive dusts or turnings when machined or ground.

Special protective equipment and precautions for fire-fighters: Firefighters should wear full emergency equipment and NIOSH approved positive pressure self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment, and emergency procedures: Wear appropriate respirator and protective clothing as needed to avoid eye contact and inhalation of dust.

Environmental precautions: Avoid release into the environmental. Report releases as required by local, state and federal authorities.

Methods and materials for containment and cleaning up: Pick up, sweep up or vacuum and place in a container for disposal. Minimize generation of dust.

7. HANDLING AND STORAGE

Precautions for safe handling: Use only with adequate ventilation. Avoid breathing dust. Wash thoroughly after handling and use, especially before eating, drinking or smoking. Refer to ANSI B7.1, Safety Requirements for the Use, Care and Protection of Abrasive Wheels for additional information. Consider potential exposure to

components of the base materials or coatings being ground. Refer to OSHA's substance specific standards for additional work practice requirements where applicable.

Conditions for safe storage, including any incompatibilities: Store in accordance with ANSI B7.1. Protect abrasive wheels from damage.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure guidelines:

Aluminum Oxide	5 mg/m3 ACGIH TLV (respirable fraction) (as Al metal) 15 mg/m3 TWA OSHA PEL (total dust) 5 mg/m3 TWA OSHA PEL (respirable fraction)
Zirconium Oxide (as zirconium compounds)	5 mg/m3 TWA ACGIH TLV 10 mg/m3 STEL ACGIH TLV 5 mg/m3 TWA OSHA PEL
Cured Phenolic Resin	None Established
Nitrile Compounds	None Established
Fluoride Compounds	2.5 mg/m3 TWA ACGIH TLV 2.5 mg/m3 TWA OSHA PEL
Iron Pyrite	None Established
Woven Fiberglass	5 mg/m3 TWA ACGIH TLV (inhalable) 1 f/cc TWA ACGIH TLV (respirable)
Calcium Compounds	None Established
Sulfur	None Established
Calcium Oxide	2 mg/m3 TWA ACGIH TLV 5 mg/m3 TWA OSHA PEL
Cryolite (as fluorides)	2.5 mg/m3 TWA ACGIH TLV 2.5 mg/m3 TWA OSHA PEL
Cured epoxy resin	None Established
Titanium Dioxide	10 mg/m3 TWA ACGIH TLV 15 mg/m3 TWA OSHA PEL (total dust)
Calcium Carbonate	15 mg/m3 TWA OSHA PEL (total dust) 5 mg/m3 TWA OSHA PEL (respirable fraction)
Iron Oxide	5 mg/m3 TWA ACGIH TLV (respirable fraction) 10 mg/m3 TWA OSHA PEL (fume)
Graphite	2 mg/m3 TWA ACGIH TLV (respirable fraction) 15 mppcf mg/m3 TWA OSHA PEL
Aluminum Potassium Fluoride (as Al metal)	5 mg/m3 ACGIH TLV (respirable fraction) (as Al metal) 15 mg/m3 TWA OSHA PEL (total dust) 5 mg/m3 TWA OSHA PEL (respirable fraction)
Aluminum Potassium Fluoride (as fluorides)	2.5 mg/m3 TWA ACGIH TLV 2.5 mg/m3 TWA OSHA PEL
Potassium Fluoroborate (as fluorides)	2.5 mg/m3 TWA ACGIH TLV 2.5 mg/m3 TWA OSHA PEL
Titanium Dioxide	10 mg/m3 TWA ACGIH TLV 15 mg/m3 TWA OSHA PEL (total dust)

Note: Consider also components of base materials and coatings being ground.

Appropriate engineering controls: Use local exhaust or general ventilation as required to minimize exposure to dust and maintain the concentration of contaminants below occupational exposure limits.

Individual protection measures, such as personal protective equipment:

Respiratory protection: Use NIOSH approved respirator if exposure limits are exceeded or where dust exposures are excessive. Consider the potential for exposure to components of the coatings or base material being ground in selecting proper respiratory protection. Refer to OSHA's specific standards for lead, cadmium, etc. where appropriate. Selection of respiratory protection depends on the contaminant type, form and concentration. Select and use respirators in accordance with OSHA 1910.134 and good industrial hygiene practice.
Skin protection: Cloth or leather gloves recommended.
Eye protection: Safety goggles or face shield over safety glasses with side shields.
Other: Protective clothing as needed to prevent contamination of personal clothing. Hearing protection may be required.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance (physical state, color, etc.): Black, brown or reddish colored solid wheel.
Odor: No Odor

Odor threshold: Not applicable	**pH:** Not applicable
Melting point/freezing point: Not applicable	**Boiling Point:** Not applicable
Flash point: Not applicable	**Evaporation rate:** Not applicable
Flammability (solid, gas): Not combustible	
Flammable limits: LEL: Not applicable	**UEL:** Not applicable
Vapor pressure: Not applicable	**Vapor density:**
Relative density: Not applicable	**Solubility(ies):** Not soluble
Partition coefficient: n-octanol/water: Not applicable	**Auto-ignition temperature:** Not applicable
Decomposition temperature: Not applicable	**Viscosity:** Not applicable

10. STABILITY AND REACTIVITY

Reactivity: Not reactive.
Chemical stability: Stable.
Possibility of hazardous reactions: None known.
Conditions to avoid: None known.
Incompatible materials: None known.
Hazardous decomposition products: Dust from grinding could contain ingredients listed in Section 3 and other, potentially more hazardous components of the base material being ground or coatings applied to the base material.

11. TOXICOLOGICAL INFORMATION

Routes of exposure:
Inhalation: Dust may cause respiratory irritation.
Ingestion: None expected under normal use conditions. Swallowing large pieces may cause obstruction of the gastrointestinal tract.
Skin contact: None expected under normal use conditions. Rubbing product across the skin may cause mechanical irritation or abrasions.
Eye contact: Dust may cause mechanical irritation.

Chronic effects from short- and long-term exposure: Long-term overexposure to respirable dust may cause lung damage (fibrosis) with symptoms of coughing, shortness of breath and diminished breathing capacity. Chronic effects may be aggravated by smoking. Prolonged overexposure to fluorides may cause a bone condition, fluorosis. Prolonged exposure to elevated noise levels during operations may affect hearing. A greater hazard, in most cases, is the exposure to the dust/fumes from the material or paint/coatings being ground. Most of the dust generated during grinding is from the base material being ground and the potential hazard from this exposure must be evaluated.

Carcinogenicity: Titanium Dioxide is listed by IARC as a group 2B Carcinogen (suspected human carcinogen). Nove of the other components is listed as a carcinogen or potential carcinogen by OSHA, NTP or IARC.

Additional Information: This SDS is applicable to product from United Abrasives only. The material being processed must be evaluated to determine any potential hazard.

This product contains titanium dioxide which has caused cancer in rats after high level exposure and inhalation. No exposure to titanium dioxide has been detected through air sampling during tests to simulate use. Thus, there are no health effects associated with titanium dioxide during the normal use of this product.

Numerical measures of toxicity:
Aluminum Oxide: LD50 Oral rat >5,000 mg/kg
Zirconium Oxide: Oral rat LD50 >5000 mg/kg
Iron Pyrite: No toxicity data available
Sulfur: Oral rat LD50 >2000 mg/kg, Inhalation rat LC50 >5.43 mg/L/4 hr, Dermal rat LD50 >200 mg/L
Calcium Oxide: Oral rat LD50 >7340 mg/kg
Cryolite: LD50 Oral rat >5,000 mg/kg
Titanium Dioxide: LD50 Oral rat >5,000 mg/kg, Inhalation rat LC50 >6.82 mg/L/4 hr
Calcium Carbonate: No toxicity data available
Iron Oxide: LD50 oral rat > 10000 mg/kg
Graphite: LD50 oral rat > 2000 mg/kg, LC50 inhalation rat > 2 mg/L
Aluminum Potassium fluoride: LD50 oral rat 2150 mg/kg, LC50 inhalation rat > 3.4 mg/L, LD50 dermal rabbit > 2000 mg/kg.
Potassium Fluoroborate: LD50 oral rat > 2000 mg/kg, LC50 inhalation rat > 5.3 mg/L
Titanium Dioxide: LD50 Oral rat >5,000 mg/kg, Inhalation rat LC50 >6.82 mg/L/4 hr

12. ECOLOGICAL INFORMATION

Ecotoxicity:
Aluminum Oxide: 96 hr LC50 Pimephales promelas 35 mg/L
Zirconium Oxide: 96 hr LC50 Danio rerio >100 mg/L, 48 hr EC50 daphnia magna >100 mg/L
Iron Pyrite: No data available
Sulfur: 96 hr LC50 Oncorhynchus mykiss > 5 µg/L (solubility limit of sulfur), 48 hr EC50 daphnia magna > 5 µg/L (solubility limit of sulfur)
Calcium oxide: 96 hr LC50 Cyprinus carpio >1070 mg/L
Cryolite: No data available
Calcium Carbonate: No data available
Iron Oxide: No data available
Graphite: Danio rerio LC50 > 100 mg/L/96hr
Aluminum Potassium fluoride: Brachydanio rerio LC50 > 10 mg/L/96h
Potassium Fluoroborate: Leuciscus idus LC50: 760 mg/L/96hr
Titanium Dioxide: 48 hr EC50 daphnia magna >500 mg/L

Persistence and degradability: Biodegradation is not applicable to inorganic compounds.
Bioaccumulative potential: No data available
Mobility in soil: No data available.
Other adverse effects: No hazards to the environment are expected from this product. However, consideration must be given to potential environment effects of the base material being processed.

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable local, state/provincial and federal regulations. Local regulations may be more stringent than regional and national requirements. It is the responsibility of the waste generator to

determine the toxicity and physical characteristics of the material to determine the proper waste identification and disposal in compliance with applicable regulations.

14. TRANSPORT INFORMATION

	UN Number	Proper shipping name	Hazard Class	Packing Group	Environmental Hazard
DOT	None	Not Regulated	None	None	
TDG	None	Not Regulated	None	None	

Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code): Not applicable – product is transported only in packaged form.

Special precautions: None identified.

15. REGULATORY INFORMATION

SARA Section 311/312 Hazard Categories: Not Applicable (manufactured articles)

SARA Section 313: This product contains the following toxic chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372 (Toxic Chemical Release Reporting): None

California Proposition 65: WARNING! You create dust when you cut, sand, drill or grind materials such as wood, paint, cement, masonry or metal. This dust often contains chemicals known to cause cancer, birth defects or other reproductive harm.

16. OTHER INFORMATION

NFPA Rating: Health = 1 Flammability = 0 Instability = 0
HMIS Rating: Health = 1* Flammability = 0 Physical Hazard =0
*Chronic health hazard

Date Previous Revision: 3/31/15
Date This Revision: 2/15/17
Revision Summary:
8/24/12: Section 3 Updated Composition, Section 8 Updated exposure limits, Section 11 Updated Acute toxicity values.
3/31/15: Changed all sections. Updated format to GHS.
9/30/16: Section 2 Classification, Hazard Phrases, Precautionary Phrases; Section 3 Composition; Section 8 Exposure guidelines; Section 11 Numerical measures of toxicity; Section 12 Ecotoxicity

The preceding information is believed to be correct and current as of the date of preparation of this Material Safety Data Sheet. Since the use of this information and the conditions of use of this product are not within the control of United Abrasives, Inc., it is the user's obligation to assure safe use of this product.

Chemsico
Division of United Industries Corp.
P. O. Box 142642
St. Louis, MO 63114-0642

Material Safety Data Sheet

Complies with OSHA's Hazard Communication Standard, 29 CFR 1910.1200

Hazardous Material Identification System – (HMIS)	
HEALTH – 1	REACTIVITY – 0
FLAMMABILITY – 2	PERSONAL –

I Trade Name: Ultra-Kill Wasp & Hornet Killer

Product Type: Aerosol insecticide

Product Item Number: HG-41241

Formula Code Number: 21-0666/21-0815

EPA Registration Number	Manufacturer	Emergency Telephone Numbers
9688-190	Chemsico Division of United Industries Corporation 8494 Chapin Industrial Drive St. Louis, MO 63114	**For Chemical Emergency:** 1-800-633-2873 **For Information:** 1-800-332-5553 **Prepared by:** Charlie Duckworth **Date Prepared:** August 14, 2007

II Hazards Ingredient/Identity Information

Chemical	%	OSHA PEL	ACGIH TLV
Mineral spirits CAS# 8012-95-1	4.00	100 ppm	100 ppm
Propylene glycol monobutyl ether CAS# 5131-66-8	6.00	None	None
Lambda-cyhalothrin CAS# 91465-08-6	0.01	NA	2000 mg/kg (skin)
Prallethrin CAS# 23031-36-9	0.025	NE	NE
Hydrocarbon Propellant blend CAS #75-28-5/106-97-8/ 74-98-6	3.50	NE	NE

III Physical and Chemical Characteristics

Appearance & Odor: Wet narrow fan spray with clear wet film and glycol ether odor.
Boiling Point: NA
Melting Point: NA
Vapor Pressure: 110 psig at 54° C/130° F
Specific Gravity: 0.993 (H_2O = 1)
Vapor Density: Greater than 1 (Air = 1)

Solubility in Water: Greater than 87%
Evaporation Rate: Less than 1 (Butyl Acetate = 1)

IV Fire and Explosive Hazards Data

Flash Point: 119° F (TCC) (liquid portion)
Flame Extension: 0-inches (Level 1 Aerosol)
Flammable Limits: NA
Autoignition Temperature: NA
Fire Extinguishing Media: Water fog, Carbon dioxide, Dry chemical
Decomposition Temperature: NA
Special Fire-Fighting Procedures: Keep cans cool. Use equipment or shielding to protect personnel against bursting, rupturing or venting cans.
Unusual Fire & Explosion Hazards: At elevated temperatures (over 54° C/130° F), cans may vent, rupture or burst. Also see Section V.

V Reactivity Data

Stability: Stable
Polymerization: Will not occur
Conditions to Avoid: Temperatures over 130° F
Incompatible Materials: NA
Hazardous Decomposition or Byproducts: Carbon dioxide, carbon monoxide

VI Health Hazard Data

Skin Contact: Avoid contact with skin and clothing. ***First Aid***: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a Poison Control Center or doctor for treatment advice.
Ingestion: First Aid: Immediately call a Poison Control Center or doctor. Do not induce vomiting unless told to do so by a Poison Control Center or doctor. Do not give any liquid to the person. Do not give anything by mouth to an unconscious person.
Special Notes: Have the product container with you when calling a Poison Control Center or doctor, or going for treatment.
Health conditions Aggravated by Exposure: None known
Ingredients listed by NTP, OSHA, or IARC as Carcinogens or Potential Carcinogens: None

VII Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled:
Avoid breathing vapors. Avoid contact with liquid. Remove ignition sources. Soak up spills with absorbent material.

Waste Disposal:
Do not puncture or incinerate containers. If empty: Place in trash or offer for recycling if available. If partly filled: Call local solid waste agency or 1-800-CLEANUP for disposal instructions.

Handling & Storage Precautions:
Do not store where temperatures can exceed 54° C/130° F.

VIII Control Measures

Read and follow label directions. They are your best guide to using this product effectively, and give necessary safety precautions to protect your health.

IX Transportation Data

DOT: Consumer Commodity, Hazard Class ORM-D (Limited Quantity Exception)
IMDG: Aerosols (Maximum 1 Liter), Hazard Class 2, UN-1950, Packing Group III
IATA: Aerosols, Flammable, Containing Substances in Division 6.1, Packing Group III (Each Not Exceeding 1 Liter Capacity), Hazard Class 2.1, UN-1950, Packing Group III

The information and statements herein are believed to be reliable but are not to be construed as warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein. NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS MADE.

SAFETY DATA SHEET

Issuing Date 10-Dec-2014 **Revision Date** 05-May-2016 **Revision Number** 2

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

GHS product identifier

Product Name **Calcium Chloride Solution**

Other means of identification

Synonyms Liquid Calcium Chloride, Food Grade Liquid Calcium Chloride, Road Master™, SuperSet™

Recommended use of the chemical and restrictions on use

Recommended Use For Diverse Applications

Uses advised against No information available

Supplier's details

Supplier Address
TETRA Technologies, Inc.
24955 Interstate 45 North
The Woodlands, TX 77380
TEL: 281-367-1983 (Non-Emergency Number)

Emergency telephone number

Emergency Telephone Number CHEMTREC: 1-800-424-9300 for US/ 703-527-3887 outside US

2. HAZARDS IDENTIFICATION

Classification

Serious Eye Damage/Eye Irritation	Category 2

GHS Label elements, including precautionary statements

Emergency Overview

Signal Word **Warning**

Hazard Statements
• Causes serious eye irritation

Appearance Colorless to amber **Physical State** Liquid. **Odor** Odorless

Precautionary Statements

Prevention

- Wash face, hands and any exposed skin thoroughly after handling.
- Wear eye/face protection.

Response

- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- If eye irritation persists: Get medical advice/attention.

Storage

- None

Disposal

- None

Hazard Not Otherwise Classified (HNOC)

Not applicable

Other information

3. COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms Liquid Calcium Chloride, Food Grade Liquid Calcium Chloride, Road Master™, SuperSet™

Chemical Name	CAS-No	Weight %	Trade secret
Calcium Chloride	10043-52-4	20-40	*

**The exact percentage (concentration) of composition has been withheld as a trade secret.*

4. FIRST AID MEASURES

Description of necessary first-aid measures

Eye Contact Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Keep eye wide open while rinsing. If symptoms persist, call a physician.

Skin Contact Wash off immediately with soap and plenty of water removing all contaminated clothes and shoes. If symptoms persist, call a physician.

Inhalation Move to fresh air in case of accidental inhalation of vapors. Remove from exposure, lie down. If symptoms persist, call a physician.

Ingestion Rinse mouth. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Drink plenty of water. Consult a physician.

Most important symptoms/effects, acute and delayed

Most Important Symptoms/Effects Irritation

Indication of immediate medical attention and special treatment needed, if necessary

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media No information available.

Specific Hazards Arising from the Chemical
No information available.

Explosion Data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	None.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal Precautions Avoid contact with the skin and the eyes. Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Do not touch or walk through spilled material.

Advice for emergency responders Wear personal protective equipment.

Environmental Precautions

Environmental Precautions Prevent product from entering drains. See Section 12 for additional Ecological Information.

Methods and materials for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so. Dike far ahead of spill; use dry sand to contain the flow of material

Methods for Cleaning Up Soak up with inert absorbent material. Pick up and transfer to properly labeled containers. After cleaning, flush away traces with water. Prevent product from entering drains.

7. HANDLING AND STORAGE

Precautions for safe handling

Handling Handle in accordance with good industrial hygiene and safety practice. Wear personal protective equipment. Avoid contact with skin, eyes and clothing. Do not breathe vapors or spray mist.

Conditions for safe storage, including any incompatibilities

Storage Keep container tightly closed in a dry and well-ventilated place. Keep in properly labeled containers.

Incompatible Products None known based on information supplied.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Calcium Chloride 10043-52-4	ACGIH - (TLV-TWA) Guidelne for nuisance particulate (inhalable particulate): 10 mg/m^3	OSHA (PEL-TWA) - Z-3 Mineral Dusts, Inert or Nuisance dusts, (respirable fraction): 5 mg/m^3	-

Appropriate engineering controls

Engineering Measures When there is a potential for exposure, an emergency eyewash and safety shower should be provided within the immediate work area.

Individual protection measures, such as personal protective equipment

Eye/Face Protection Wear safety glasses with non-flexible side shields or chemical goggles A face shield should be worn if a potential for splashing or spraying exists.

Skin and Body Protection Wear appropriate protective non-leather protective gloves and boots. Wear appropriate protective, impervious clothing. Chemical protective gloves and boots such as PVC, Neoprene, or Heavy Nitrile are recommended. Leather products do not offer adequate protection and will dehydrate with resultant shrinkage and possible destruction

Respiratory Protection A respirator is not indicated under normal operating conditions. Use of a NIOSH - approved respirator (N95 or greater) should be based on the presence of nuisance dusts.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State Liquid
Appearance Colorless to amber
Odor Odorless
Odor Threshold No information available

Property	Values	Remarks/ - Method
pH	3.8 - 9.0	None known
Melting Point/Range	Not determined	None known
Boiling Point/Boiling Range	118 °C / 244 °F	for 38% liquid solution
Flash Point	Not applicable.	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limits in Air		
upper flammability limit	No data available	
lower flammability limit	No data available	
Vapor Pressure	No data available	None known
Vapor Density	No data available	None known
Specific Gravity	1.376 @ 25 C (77 F) for 38% solution	None known
Water Solubility	Completely soluble	None known
Solubility in other solvents	No data available	None known
Partition coefficient: n-octanol/water	Not determined	None known
Autoignition Temperature	No data available	None known
Decomposition Temperature	No data available	None known
Viscosity	Not applicable	None known

Flammable Properties Not flammable

Explosive Properties No data available
Oxidizing Properties No data available

Other information

VOC Content (%) Not applicable.

10. STABILITY AND REACTIVITY

Reactivity

No data available.

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

None under normal processing.

Hazardous Polymerization

Hazardous polymerization does not occur.

Conditions to avoid

None known based on information supplied.

Incompatible materials

None known based on information supplied.

Hazardous decomposition products

None known based on information supplied.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Product Information

Inhalation	May cause irritation.
Eye Contact	Irritating to eyes.
Skin Contact	Slightly toxic by dermal absorption.
Ingestion	May cause irritation.

Chemical Name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Calcium Chloride	= 2301 mg/kg (Rat)	= 2630 mg/kg (Rat)	-

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms No information available.

Delayed and immediate effects and also chronic effects from short and long term exposure

Sensitization	No information available.
Mutagenic Effects	No information available.
Carcinogenicity	Contains no ingredients above reportable quantities listed as a carcinogen.

Reproductive Toxicity No information available.
STOT - single exposure No information available.
STOT - repeated exposure No information available.
Aspiration Hazard No information available.

Numerical measures of toxicity - Product
No information available.

12. ECOLOGICAL INFORMATION

Ecotoxicity
The environmental impact of this product has not been fully investigated.

Chemical Name	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Calcium Chloride 10043-52-4		LC50 96 h: = 10650 mg/L static (Lepomis macrochirus)		LC50 48 h: = 2400 mg/L (Daphnia magna)

Persistence and Degradability No information available.

Bioaccumulation No information available.

Other Adverse Effects
No information available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods This material, as supplied, is not a hazardous waste according to Federal regulations (40 CFR 261). This material could become a hazardous waste if it is mixed with or otherwise comes in contact with a hazardous waste, if chemical additions are made to this material, or if the material is processed or otherwise altered. Consult 40 CFR 261 to determine whether the altered material is a hazardous waste. Consult the appropriate state, regional, or local regulations for additional requirements.

Contaminated Packaging Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT Not regulated

IATA Not regulated

IMDG Not regulated

15. REGULATORY INFORMATION

International Inventories

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

U.S. Federal Regulations

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act
This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

U.S. State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

U.S. EPA Label Information
EPA Pesticide Registration Number Not applicable

16. OTHER INFORMATION

NFPA	**Health Hazard**	1	**Flammability**	0	**Instability** 0	**Physical and Chemical Hazards**	-
HMIS	**Health Hazard**	1	**Flammability**	0	**Physical Hazard** 0	**Personal Protection**	X

Prepared By	TETRA Technologies, Inc. sds@tetratec.com
Issuing Date	10-Dec-2014
Revision Date	05-May-2016
Revision Note	Updated product concentration.

General Disclaimer
The information provided on this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of Safety Data Sheet

Safety Data Sheet

Chemical Name: Propane

Synonyms: Dimethylmethane, Liquefied Petroleum Gas (LPG), Sales Propane, Commercial Propane, Refinery Propane, Product Propane (non-odorized)

Section 1 - Chemical Product and Company Identification

Company Information

Ferrellgas (Blue Rhino)
One Liberty Plaza
Liberty, MO 64068
Emergency # 800-424-9300 (CHEMTREC)
General SDS assistance # 855-738-9178 (Ferrellgas Safety Department)

Product Information

Product: Propane (odorized)
Chemical Name: Propane
Chemical Family: Liquified Petroleum Gas (Paraffinic Hydrocarbons)
Chemical Formula: C_3H_8

Section 2 - Hazards Identification

GHS Classification:

Flammable Gas - Category 1
Gases Under Pressure - Liquefied Gas

GHS LABEL ELEMENTS

Pictogram(s)

Signal Word

Danger

Hazard Statements

H220 - Extremely flammable gas.
H280 - Contains gas under pressure, may explode if heated.

Precautionary Statements

Prevention
P210 - Keep away from heat/sparks/open flames/hot surfaces. No smoking
Response
P376 - Stop leak if safe to do so.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
Storage
P403 - Store in a well-ventilated place.
P405 - Store locked up.
P410 - Protect from sunlight.
Disposal
P501 - Dispose of contents/container in accordance with local/regional/national/international regulations.

Section 3 - Composition / Information on Ingredients

CAS #	Component	Percent
74-98-6	Propane	85 - 100
106-97-8	Butane and heavier	0 - 2.5
74-84-0	Ethane	0 - 5
115-07-1	Propylene	0 - 10
75-08-1	Ethyl Mercaptan	0 - 0.0025

Section 4 - First Aid Measures

First Aid: Eyes

Direct contact with liquid propane can result in eye burns.
In case of contact with eyes, hold eyelids open to allow liquid to evaporate and gently flush with lukewarm water. Cover eyes to protect from light. Seek immediate medical attention.

First Aid: Skin

Direct contact with liquid propane can result in skin burns (frostbite).
Remove contaminated clothing. In case of blistering, frostbite or freeze burns seek immediate medical attention.

First Aid: Ingestion

Risk of ingestion is extremely low. However, if oral exposure occurs, seek immediate medical assistance.

First Aid: Inhalation

This product is classified as a simple asphyxiant. High vapor concentrations may produce a reversible central nervous system depression (anesthesia) and asphyxiation.
Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

Section 5 - Fire Fighting Measures

General Fire Hazards

See Section 9 for Flammability Properties.
Liquid releases flammable vapors at well below ambient temperatures and readily forms a flammable mixture with air. Dangerous fire and explosion hazard when exposed to heat, sparks or flame. Vapors are heavier than air and may travel long distances to a point of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

Use extinguishing media suitable for the surrounding material, preferably or, any extinguisher suitable for Class B fires, dry chemical, fire fighting foam, CO_2, and other gaseous agents. However, fire should not be extinguished unless flow of gas can be immediately stopped.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Gas fires should not be extinguished unless flow of gas can be immediately stopped. Shut off gas source and allow gas to burn out. If spill or leak has not ignited, determine if water spray may assist in dispersing gas or vapor to protect personnel attempting to stop leak. Use water to cool equipment, surfaces and containers exposed to fire and excessive heat. For large fire the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Isolate area, particularly around ends of storage vessels. Let vessel, tank car or container burn unless leak can be stopped. Withdraw immediately in the event of a rising sound from a venting safety device. Large fires typically require specially trained personnel and equipment to isolate and extinguish the fire.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

Section 6 - Accidental Release Measures

Recovery and Neutralization

Stop the source of the release, if safe to do so.

Materials and Methods for Clean-Up

Do not flush down sewer or drainage systems. Do not touch spilled liquid (frostbite/freeze burn hazard!). Consider the use of water spray to disperse vapors. Isolate the area until gas has dispersed. Ventilate and gas test area before entering.

Emergency Measures

Evacuate nonessential personnel and secure all ignition sources. No road flares, smoking or flames in hazard area. Consider wind direction, stay upwind and uphill, if possible. Evaluate the direction of product travel. Vapor cloud may be white, but color will dissipate as cloud disperses - fire and explosion hazard is still present!

Personal Precautions and Protective Equipment

Do not touch spilled liquid (frostbite/freeze burn hazard!).

Environmental Precautions

Do not flush down sewer or drainage systems.

Prevention of Secondary Hazards

None

Section 7 - Handling and Storage

Handling Procedures

Keep away from flame, sparks, ingnition sources and excessive temperatures. Use only in well ventilated areas.

Storage Procedures

Store only in approved containers. Keep away from flame, sparks, excessive temperatures and open flame. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Incompatibilities

Keep away from strong oxidizers, ignition sources and heat. Explosion hazard when exposed to chlorine dioxide. Heating barium peroxide with propane causes violent exothermic reaction. Heated chlorine-propane mixtures are explosive under some conditions.

Section 8 - Exposure Controls / Personal Protection

Component Exposure Limits

Propane (74-98-6)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases: Alkane C1-4)
OSHA: 1000 ppm TWA; 1800 mg/m3 TWA
NIOSH: 1000 ppm TWA; 1800 mg/m3 TWA

Ethane (74-84-0)

ACGIH: 1000 ppm TWA (listed under Aliphatic hydrocarbon gases: Alkane C1-4)

Propylene (115-07-1)

ACGIH: 500 ppm TWA

Engineering Measures

Use adequate ventilation to keep gas and vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces. Use explosion-proof equipment and lighting in classified/controlled areas.

Personal Protective Equipment: Respiratory

Use a NIOSH approved positive-pressure, supplied air respirator with escape bottle or self-contained breathing apparatus (SCBA) for gas concentrations above occupational exposure limits, for potential for uncontrolled release, if exposure levels are not known, or in an oxygen-deficient atmosphere. CAUTION: Flammability limits (i.e., explosion hazard) should be considered when assessing the need to expose personnel to concentrations requiring respiratory protection.

Personal Protective Equipment: Hands

Use cold-impervious, insulating gloves where contact with liquid may occur.

Personal Protective Equipment: Eyes

Where there is a possibility of liquid contact, wear splash-proof safety glasses and faceshield.

Personal Protective Equipment: Skin and Body

Where contact with liquid may occur, wear appropriate cold insulating protective clothing and faceshield.

Section 9 - Physical & Chemical Properties

Appearance:	Colorless	Odor:	Odorless
Physical State:	Gas	pH:	ND
Max Vapor Pressure:	208 psig @ 100 °F (37.8 °C)	Vapor Density:	1.56 @ 32°F (0°C)
Boiling Point:	-43.8°F (-42.1°C)	Molecular Weight:	44.096
Solubility (H2O):	slight (0.1 to 1.0%)	Specific Gravity:	1.52 (Air = 1)
Expansion Ratio:	1 to 270 (from liquid to gas @ 14.7 psia)	Burning Rate:	ND
Evaporation Rate:	ND	VOC:	ND
Octanol/H2O Coeff.:	ND	Flash Point:	-156°F (-104 °C)
Flash Point Method:	PMCC	Auto Ignition:	842°F (450°C)
Upper Flammability Limit (UFL):	9.6%		
Lower Flammability Limit (LFL):	2.15%		

Section 10 - Chemical Stability & Reactivity Information

Chemical Stability

This is a stable material.

Hazardous Polymerization

Will not occur.

Conditions to Avoid

Keep away from strong oxidizers, ignition sources and heat.

Incompatible Products

Explosion hazard when exposed to chlorine dioxide. Heating barium peroxide with propane causes violent exothermic reaction. Heated chlorine-propane mixtures are explosive under some conditions.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke) may be formed during combustion.

Section 11 - Toxicological Information

Acute Toxicity

A: General Product Information

Propane exhibits some degree of anesthetic action and is mildly irritating to the mucous membranes. At high concentrations propane acts as a simple asphyxiant without other significant physiological effects. High concentrations may cause death due to oxygen depletion.

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Vapors are not irritating. Direct contact to skin or mucous membranes with liquefied product or cold vapor may cause freeze burns and frostbite. Contact to mucous membranes with liquefied product may cause frostbite and freeze burns. Signs of frostbite include a change in the color of the skin to gray or white, possibly followed by blistering. Skin may become inflamed and painful.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Vapors are not irritating. However, contact with liquid or cold vapor may cause frostbite, freeze burns, and permanent eye damage.

Potential Health Effects: Ingestion

Ingestion is unlikely. Contact with mucous membranes with liquefied product may cause frostbite and freeze burns.

Potential Health Effects: Inhalation

This product is considered to be non-toxic by inhalation. Inhalation of high concentrations may cause central nervous system depression such as dizziness, drowsiness, headache, and similar narcotic symptoms, but no long-term effects. Numbness, a "chilly" feeling, and vomiting have been reported from accidental exposures to high concentrations. This product is a simple asphyxiant. In high concentrations it will displace oxygen from the breathing atmosphere, particularly in confined spaces. Signs of asphyxiation will be noticed when oxygen is reduced to below 16%, and may occur in several stages. Symptoms may include rapid breathing and pulse rate, headache, dizziness, visual disturbances, mental confusion, incoordination, mood changes, muscular weakness, tremors, cyanosis, narcosis and numbness of the extremities. Unconsciousness leading to central nervous system injury and possibly death will occur when the atmospheric oxygen concentration is reduced to about 6% to 8% or less.

WARNING: The burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This product is not reported to have any mutagenic effects.

Carcinogenicity

A: General Product Information

This product is not reported to have any carcinogenic effects.

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ repeat effects.

Aspiration Respiratory Organs Hazard

This product is not reported to have any aspiration hazard effects.

Section 12 - Ecological Information

Ecotoxicity

A: General Product Information

Liquid release is only expected to cause localized, non-persistent environmental damage, such as freezing. Biodegradation of this product may occur in soil and water. Volatilization is expected to be the most important removal process in soil and water. This product is expected to exist entirely in the vapor phase in ambient air.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

No ecotoxicity data is available for this product's components.

Persistence/Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

Section 13 - Disposal Considerations

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents/container in accordance with local/regional/national/international regulations.

Section 14 - Transportation Information

DOT Information

UN #: 1075 or 1978 Hazard Class: 2.1

Shipping Name: Petroleum Gases, Liquefied

Placard:

Section 15 - Regulatory Information

Regulatory Information

Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Propylene (115-07-1)

SARA 313: 1.0 % de minimis concentration

SARA Section 311/312 – Hazard Classes

Acute Health	Chronic Health	Fire	Sudden Release of Pressure	Reactive
--	--	X	X	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION PERCENT BY VOLUME
Propylene (115-07-1)	30 max

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Propane	74-98-6	No	Yes	Yes	Yes	Yes	Yes
Ethane	74-84-0	No	Yes	Yes	Yes	Yes	Yes
Propylene	115-07-1	Yes	Yes	Yes	Yes	Yes	Yes

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS #	TSCA	CAN	EU
Propane	74-98-6	Yes	DSL	EINECS
Ethane	74-84-0	Yes	DSL	EINECS
Propylene	115-07-1	Yes	DSL	EINECS

* * * Section 16 - Other Information * * *

NFPA® Hazard Rating	Health	2	
	Fire	4	
	Reactivity	0	

HMIS® Hazard Rating	Health	2	Moderate
	Fire	4	Severe
	Physical	0	Minimal

Key/Legend

EPA = Environmental Protection Agency; TSCA = Toxic Substance Control Act; ACGIH = American Conference of Governmental Industrial Hygienists; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NTP = National Toxicology Program; OSHA = Occupational Safety and Health Administration., NJTSR = New Jersey Trade Secret Registry; TSCA = Toxic Substance Control Act; EU = European Union; CAN = Canada

Literature References

None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

Issue Information

This Safety Data Sheet supersedes all previous editions.

Issued: January, 2015

Issued by: Ferrellgas Safety Department

Ferrellgas
One Liberty Plaza
Liberty, MO 64068

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St. Louis, MO 63166-6800
888-237-7611 | 618-337-6000
cerroflow.com

SAFETY DATA SHEET

SECTION 1. IDENTIFICATION

Copper Tubing (all sizes and wall thicknesses)

Cerro Flow Products LLC
PO Box 66800, St Louis, MO 63166-6800 Telephone number 618-337-6000

Recommended use: Plumbing and industrial copper tubing. Restricted use: None known

SECTION 2. HAZARD IDENTIFICATION

CAUTION

Inhalation Hazard Fumes are created by heating copper past its melting point. Proper soldering or sweating copper tubes will not produce fumes. Brazing of copper tube may produce fumes. Consult the Copper Development Association Inc. (CDA) "The Copper Tube Handbook" for proper joining methods, and recommended solders, fluxes and filler metals (see CDA link on www.cerroflow.com to obtain handbook).

Ingestion Hazard Ingestion of metallic copper is not a primary route of exposure. Metallic copper may be moderately irritating to the gastrointestinal tract.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

MATERIAL OR COMPONENT	C.A.S. No.	WT. %
Copper	**7440-50-8**	**99.9+**

SECTION 4. FIRST AID MEASURES

Inhalation: Remove from exposure; place individual under care of a physician.
Ingestion: Induce vomiting in conscious individual and call a physician.
Skin or Eyes; Flush with plenty of water. If symptoms develop, consult a physician.

SECTION 5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS	FIRE EXTINGUISHING AGENTS RECOMMENDED	FIRE EXTINGUISHING AGENTS TO AVOID
Not Applicable	**No specific agents recommended**	**No specific agents recommended**

SPECIAL FIRE FIGHTING PRECAUTIONS
Copper tube will not burn or give off toxic gases in normal fires Use fire fighting methods compatible with surrounding materials.

SECTION 6. RELEASE MEASURES

SPILLS OR LEAKS
Proper installation of copper tubing will not produce dust. Consult Copper Development Association, Inc (CDA)"The Copper Tube Handbook" for proper joining methods (See CDA link on http://www.cerroflow.com to obtain handbook) Vacuuming is preferred for dust. Do not use compressed air for cleaning. Recycle unused or scrap copper tube at a local scrap metal dealer.

SECTION 7. HANDLING AND STORAGE

NORMAL HANDLING

Avoid conditions which create fumes or fine dust. Use of approved respirators is required where adequate ventilation cannot be provided. Do not use copper tubing where incompatible materials may be present, (see section X).

STORAGE

Avoid storage near incompatible materials, see Section 10.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Permissible Air Conc. (mg/m3)			
	OSHA		ACGIH
Dust	1.0		1.0
Fume	0.1		0.2

ENGINEERING CONTROLS .

Local exhaust is recommended for dust and/or fume generating operations where airborne exposure may exceed permissible air concentrations.

PERSONAL HYGIENE

Avoid inhalation or ingestion. Practice good housekeeping and personal hygiene procedures. Showering is recommended if significant dust exposure occurs.

SPECIAL: PRECAUTIONS/PROCEDURES/LABEL INSTRUCTIONS **LABEL SIGNAL WORD:**

No special precautions. **NOT APPLICABLE**

RESPIRATORY PROTECTION

Where airborne exposures may exceed OSHA/ACGIH permissible air concentrations, the minimum respiratory protection recommended is a negative pressure air purifying respirator with cartridges that are NIOSH/MSHA approved against dust, fumes, and mists having a TWA not less than 0.05 mg/m3

EYES AND FACE

Safety glasses recommended when dust or shavings may exist.

OTHER CLOTHING AND EQUIPMENT

Protective clothing is recommended to prevent burns during installation of tube or splattering of fluxes, solder or filler metals.

SECTION 9. PHYSICAL/CHEMICAL PROPERTIES

MATERIAL IS (AT NORMAL CONDITIONS)	APPEARANCE AND ODOR
Solid	Yellow-red metal, various shapes and sizes.

MELTING POINT (DEGREES C)	BOILING POINT (DEGREES C)	SPECIFIC GRAVITY (H2O = 1)	VAPOR DENSITY (AIR = 1)
1083	2595	8.96	Not applicable

SOLUBILITY IN WATER (% BY WT.)	pH	VAPOR PRESSURE (mm Hg)	EVAPORATION RATE
Insoluble	Not Applicable	Not Applicable	Not Applicable

SECTION 10. STABILITY AND REACTIVITY

STABILITY	CONDITIONS TO AVOID
Stable	Not Applicable

INCOMPATIBILITY (MATERIALS TO AVOID)

Reacts violently with acetylene, hydrogen peroxides, gaseous chlorine, ammonia nitrate, bromates, chlorates, hydrogen sulfide, lead azide, and hydrazine.

HAZARDOUS DECOMPOSITION PRODUCTS	HAZARDOUS POLYMERIZATION	CONDITIONS TO AVOID
Copper does not decompose	Will not occur	Not Applicable

SECTION 11. TOXICOLOGICAL INFORMATION

PRIMARY ROUTES OF ENTRY **INHALATION** **CARCINOGENICITY** .

X **Not listed as a carcinogen by NTP, IARC, or OSHA**

ACUTE OVER EXPOSURE (SYMPTOMS AND EFFECTS)

A. Fumes are created by heating metallic copper past its melting point. Proper soldering or sweating copper tubes will not produce fumes. Brazing of copper tube may produce fumes. Consult Copper Development Association, Inc. (CDA) "The Copper Tube Handbook" for proper joining methods, and recommended solders, fluxes and filler metals (see CDA link on Cerro Flow Products, LLC website to obtain handbook). Use approved ventilation or respiratory protection if the possibility of fumes exists. Inhalation of fume may cause irritation of the respiratory tract or metal fume fever (chills, fever, aching muscles, dry mouth and throat, headache, nausea, vomiting, and diarrhea). Onset may be delayed several hours.

B. Ingestion of metallic copper is not a primary route of exposure. Metallic copper may be moderately irritating to the gastrointestinal tract.

CHRONIC OVEREXPOSURE (SYMPTOMS AND EFFECTS)

No long term effects. Skin irritation or discoloration of the skin and hair are short term.

MEDICAL CONDITIONS POSSIBLY AGGRAVATED

Wilson's Disease (an abnormal genetic condition) could be aggravated.

LD50 (SPECIES, ROUTE)	LC50 (SPECIES)	MUTAGENICITY .
Copper: 3.5 mg/kg (mouse, intraperitoneal)	**Not Available**	**Not positive in Ames test**

Health Hazard Ratings				
	Health	Flammability	Reactivity	Other
NFPA	1	0	0	
HMIS	1	0	0	E

SECTION 12. ECOLOGICAL

ECOTOXICITY **ENVIRONMENTAL FATE** .

The LC50 for copper in the fathead minnow is 12 mg/L. Acid solutions promote mobility and solubility of copper.

SECTION 13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHODS (DISPOSER MUST COMPLY WITH FEDERAL, STATE, AND LOCAL DISPOSAL OR DISCHARGE LAWS) .

Recycling or disposal must be in accordance with the appropriate federal, state, or local statutes or regulations.

SECTION 14. TRANSPORT

DOT REGULATION AND ID (OR PIN) NUMBER .

Not a DOT controlled material (United States).

Special Provisions for Transport: Marine Pollutant

SECTION 15. REGULATORY INFORMATION

WHMIS CLASSIFICATION, SARA REGULATION AND OTHER INFORMATION .

WHMIS does not classify this material

TSCA Status ---------- On TSCA Inventory

Regulated under SARA Title III:

Sect. 302 ---------- None

Sect. 311/312 ---------- Immediate and Delayed

Sect. 313 Chemicals ---------- Copper

CERCLA Reportable Quantity ------ 5,000 pounds for Copper Powder

Federal and State Regulations:

Pennsylvania RTK: Copper Massachusetts RTK: Copper TSCA 8(b) inventory: Copper CERCLA: Hazardous substances. Copper

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

SECTION 16. OTHER INFORMATION

ISSUED DATE **SUPERSEDES .**
October 1, 2016 **August 15, 2013**

PERMISSIBLE CONCENTRATION REFERENCE .
OSHA regulations for airborne contaminants 29 CFR 1910.1000 and 1018; ACGIH Threshold Limit Values for Chemical Substances

HAZARD INFORMATION REFERENCES .
Documentation Up to date, curated data provided by Mathematica's ElementData function from Wolfram Research, Inc

GENERAL .
Copper Development Association, The Copper Tube Handbook, 2016

Notes

No additional information.

THE INFORMATION AND RECOMMENDATIONS SET FORTH HEREIN ARE TAKEN FROM SOURCES BELIEVED TO BE ACCURATE AS OF THE DATE HEREOF; HOWEVER, CERRO FLOW PRODUCTS LLC MAKES NO WARRANTY WITH RESPECT TO THE ACCURACY OF THE INFORMATION OR THE SUITABILITY OF THE RECOMMENDATIONS, AND ASSUMES NO LIABILITY TO ANY USER THEREOF.

Methanol, Lab Grade, 4L

SECTION 1 : Identification of the substance/mixture and of the supplier

Product name : **Methanol, Lab Grade, 4L**

Manufacturer/Supplier Trade name:

Manufacturer/Supplier Article number: **S25426A**

Recommended uses of the product and uses restrictions on use:

Manufacturer Details:

AquaPhoenix Scientific
9 Barnhart Drive, Hanover, PA 17331

Supplier Details:

Fisher Science Education
15 Jet View Drive, Rochester, NY 14624

Emergency telephone number:

Fisher Science Education Emergency Telephone No.: 800-535-5053

SECTION 2 : Hazards identification

Classification of the substance or mixture:

Flammable
Flammable liquids, category 2

Toxic
Acute toxicity (oral, dermal, inhalation), category 3

Health hazard
Specific target organ toxicity following single exposure, category 1

AcTox Dermal. 3
Flammable liq. 2
AcTox Oral. 3
AcTox Inhaln. 3
Stot SE. 1

Signal word :Danger

Hazard statements:
Highly flammable liquid and vapour
Toxic if swallowed
Toxic in contact with skin
Toxic if inhaled
Causes damage to organs

Precautionary statements:
If medical advice is needed, have product container or label at hand
Keep out of reach of children
Read label before use

Wear protective gloves/protective clothing/eye protection/face protection
Wash skin thoroughly after handling
Do not eat, drink or smoke when using this product
Avoid breathing dust/fume/gas/mist/vapours/spray
Keep away from heat/sparks/open flames/hot surfaces. No smoking
Do not breathe dust/fume/gas/mist/vapours/spray
Specific treatment (see supplemental first aid instructions on this label)
IF ON SKIN: Wash with soap and water
Call a POISON CENTER or doctor/physician if you feel unwell
Specific measures (see supplemental first aid instructions on this label)
Take off contaminated clothing and wash before reuse
Wash contaminated clothing before reuse
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
IF exposed: Call a POISON CENTER or doctor/physician
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Store locked up
Store in a well ventilated place. Keep cool
Dispose of contents and container as instructed in Section 13

Other Non-GHS Classification:

WHMIS

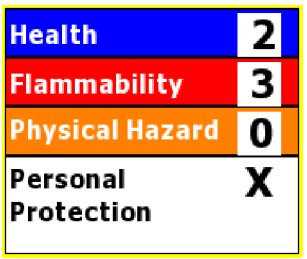
B2

D1B

D2B

NFPA/HMIS

NFPA SCALE (0-4)



HMIS RATINGS (0-4)

SECTION 3 : Composition/information on ingredients

Ingredients:		
CAS 67-56-1	Methanol	>90 %

Percentages are by weight

SECTION 4 : First aid measures

Description of first aid measures

After inhalation: Move exposed individual to fresh air. Loosen clothing as necessary and position individual in a comfortable position.Get medical assistance.If breathing is difficult, give oxygen

After skin contact: Wash affected area with soap and water. Rinse/flush exposed skin gently using water for 15-20 minutes. Seek medical attention if irritation persists or if concerned.

After eye contact: Protect unexposed eye. Rinse or flush eye gently with water for at least 15-20 minutes, lifting upper and lower lids.Seek medical attention if irritation persists or if concerned

After swallowing: Rinse mouth thoroughly. Do not induce vomiting. Have exposed individual drink sips of water. Dilute mouth with water or milk after rinsing.Get medical assistance.

Most important symptoms and effects, both acute and delayed:

Poison. Toxic by ingestion, absorption through skin and inhalation, potentially causing irreversible effects. Irritating to eyes, skin, and respiratory tract. Irritation- all routes of exposure.Shortness of breath.Nausea.Headache.May be fatal or cause blindness if swallowed. Cannot be made non-poisonous. May cause gastrointestinal irritation, vomiting, and diarrhea. Central nervous system disorders. Skin disorders, preexisting eye disorders, gastrointestinal tract;Toxic: danger of very serious irreversible effects by inhalation, ingestion or absorption through skin. Experiments have shown reproductive toxicity effects on laboratory animals. May cause adverse kidney and liver effects

Indication of any immediate medical attention and special treatment needed:

If seeking medical attention, provide SDS document to physician.Physician should treat symptomatically.

SECTION 5 : Firefighting measures

Extinguishing media

Suitable extinguishing agents: Dry chemical, foam, dry sand, or Carbon Dioxide.Water spray can keep containers cool.

For safety reasons unsuitable extinguishing agents: Water may be ineffective.

Special hazards arising from the substance or mixture:

Risk of ignition. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Containers may explode when heated

Advice for firefighters:

Protective equipment: Wear protective eyeware, gloves, and clothing. Refer to Section 8.

Additional information (precautions): Remove all sources of ignition. Avoid contact with skin, eyes, and clothing.Ensure adequate ventilation.Take precautions against static discharge.

SECTION 6 : Accidental release measures

Personal precautions, protective equipment and emergency procedures:

Use spark-proof tools and explosion-proof equipment.Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapor and mists below the applicable workplace exposure limits (Occupational Exposure Limits-OELs) indicated above.Ensure adequate ventilation.

Environmental precautions:

Prevent from reaching drains, sewer or waterway. Should not be released into environment.

Methods and material for containment and cleaning up:

If necessary use trained response staff or contractor. Remove all sources of ignition. Contain spillage and then

collect. Do not flush to sewer.Absorb with a noncombustible absorbent material such as sand or earth and containerize for disposal. Ventilate area of leak or spill.Use spark-proof tools and explosion-proof equipment.Follow proper disposal methods. Refer to Section 13.

Reference to other sections:

SECTION 7 : Handling and storage

Precautions for safe handling:

Use in a chemical fume hood. Wash hands before breaks and immediately after handling the product.Avoid contact with skin, eyes, and clothing.Take precautions against static discharge.

Conditions for safe storage, including any incompatibilities:

Store in a cool location. Provide ventilation for containers. Avoid storage near extreme heat, ignition sources or open flame. Keep container tightly sealed.Store with like hazards. Protect from freezing and physical damage.

SECTION 8 : Exposure controls/personal protection

Control Parameters:	67-56-1, Methanol, ACGIH: 250 ppm STEL; 200 ppm TWA 67-56-1, Methanol, NIOSH: 250 ppm STEL; 325 mg/m3 STEL 67-56-1, Methanol, NIOSH: 200 ppm TWA; 260 mg/m3 TWA
Appropriate Engineering controls:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling. Ensure that dust-handling systems (exhaust ducts, dust collectors, vessels, and processing equipment) are designed to prevent the escape of dust into the work area.
Respiratory protection:	Use in a chemical fume hood. If exposure limit is exceeded, a full-face respirator with organic cartridge may be worn.
Protection of skin:	Select glove material impermeable and resistant to the substance.Select glove material based on rates of diffusion and degradation.
Eye protection:	Safety glasses with side shields or goggles.
General hygienic measures:	Wash hands before breaks and at the end of work. Avoid contact with the eyes and skin.Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices.Perform routine housekeeping.

SECTION 9 : Physical and chemical properties

Appearance (physical state,color):	Clear colorless liquid	**Explosion limit lower**: **Explosion limit upper**:	6 31
Odor:	Alcohol	**Vapor pressure**:	128 hPa @ 20°C
Odor threshold:	Not Available	**Vapor density**:	1.11
pH-value:	Not Available	**Relative density**:	0.79
Melting/Freezing point:	-98°C	**Solubilities**:	Miscible at 20 °C

Boiling point/Boiling range:	64.7°C @ 760mmHg	**Partition coefficient (n-octanol/water)**:	Not Available
Flash point (closed cup):	12°C	**Auto/Self-ignition temperature**:	455°C
Evaporation rate:	5.2	**Decomposition temperature**:	Not Available
Flammability (solid,gaseous):	Flammable	**Viscosity**:	a. Kinematic:Not Available b. Dynamic: Not Available
Density: Not Available			

SECTION 10 : Stability and reactivity

Reactivity: Vapours may form explosive mixture with air.
Chemical stability: Stable under normal conditions.
Possible hazardous reactions: None under normal processing.
Conditions to avoid: Excess heat, Incompatible Materials, flames, or sparks.
Incompatible materials: Oxidizing agents, reducing agents, alkali metals, acids, sodium, potassium, metals as powders, acid chlorides, acid anhydrides, powdered magnesium, and aluminum.
Hazardous decomposition products:carbon monoxide, formaldehyde.

SECTION 11 : Toxicological information

Acute Toxicity:		
Dermal:	(rabbit)	LD-50 15800 mg/kg
Oral:	(rat)	LD-50 5628 mg/kg
Inhalation:	(rat)	LC-50 130,7 mg/l
Chronic Toxicity: No additional information.		
Corrosion Irritation:		
Ocular:		Irritating to eyes
Dermal:		Irritating to skin
Sensitization:		No additional information.
Single Target Organ (STOT):		Classified as causing damage to organs:Eyes, skin, optic nerve, gastrointestinal tract, central nervous system, respiratory system, liver, spleen, kidney, blood
Numerical Measures:		No additional information.
Carcinogenicity:		Teratogenicity : has occurred in experimental animals.
Mutagenicity:		Mutagenetic effects have occurred in experimental animals.

Reproductive Toxicity:	Developmental Effects (Immediate/Delayed) have occurred in experimental animals

SECTION 12 : Ecological information

Ecotoxicity

Freshwater Fish: 96 Hr LC50 Pimephales promelas: 28200 mg/L

Freshwater Fish: 96 Hr LC50 Oncorhynchus mykiss: 19500 - 20700 mg/L

Freshwater Fish: 96 Hr LC50 Pimephales promelas: >100 mg/L

Freshwater Fish: 96 Hr LC50 Oncorhynchus mykiss: 18 - 20 mL/L

Freshwater Fish: 96 Hr LC50 Lepomis macrochirus: 13500 - 17600 mg/L

Persistence and degradability: Not persistant.
Bioaccumulative potential: Not Bioaccumulative.
Mobility in soil: Aqueous solution has high mobility in soil.
Other adverse effects:

SECTION 13 : Disposal considerations

Waste disposal recommendations:

Methanol RCRA waste code U154. Do not allow product to reach sewage system or open water.It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities (US 40CFR262.11). Absorb with a noncombustible absorbent material such as sand or earth and containerize for disposal. Provide ventilation. Have fire extinguishing agent available in case of fire. Eliminate all sources of ignition.Use spark-proof tools and explosion-proof equipment.Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations. Ensure complete and accurate classification.

SECTION 14 : Transport information

UN-Number

UN1230

UN proper shipping name

Methanol

Transport hazard class(es)

Class:
3 Flammable liquids

Class:
6.1 Toxic substances

Packing group:II
Environmental hazard:
Transport in bulk:
Special precautions for user:

SECTION 15 : Regulatory information

United States (USA)

SARA Section 311/312 (Specific toxic chemical listings):

Acute, Chronic, Fire

SARA Section 313 (Specific toxic chemical listings):

67-56-1 Methanol

RCRA (hazardous waste code):

67-56-1 Methanol RCRA waste code U154

TSCA (Toxic Substances Control Act):

All ingredients are listed.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act):

67-56-1 Methanol 5000 lbs

Proposition 65 (California):

Chemicals known to cause cancer:

None of the ingredients is listed

Chemicals known to cause reproductive toxicity for females:

None of the ingredients is listed

Chemicals known to cause reproductive toxicity for males:

None of the ingredients is listed

Chemicals known to cause developmental toxicity:

67-56-1 Methanol

Canada

Canadian Domestic Substances List (DSL):

All ingredients are listed.

Canadian NPRI Ingredient Disclosure list (limit 0.1%):

None of the ingredients is listed

Canadian NPRI Ingredient Disclosure list (limit 1%):

67-56-1 Methanol

SECTION 16 : Other information

This product has been classified in accordance with hazard criteria of the Controlled Products Regulations and the SDS contains all the information required by the Controlled Products Regulations.Note:. The responsibility to provide a safe workplace remains with the user.The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment.The information contained herein is, to the best of our knowledge and belief, accurate.However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material.It is the responsibility of the user to comply with all applicable laws and regulations applicable to this material.

GHS Full Text Phrases:

Abbreviations and acronyms:

IMDG: International Maritime Code for Dangerous Goods
PNEC: Predicted No-Effect Concentration (REACH)

CFR: Code of Federal Regulations (USA)
SARA: Superfund Amendments and Reauthorization Act (USA)
RCRA: Resource Conservation and Recovery Act (USA)
TSCA: Toxic Substances Control Act (USA)
NPRI: National Pollutant Release Inventory (Canada)
DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
DNEL: Derived No-Effect Level (REACH)

Effective date : 01.08.2015
Last updated : 03.27.2015

APPENDIX B

CONTROL MECHANISMS

The following Control Methods should be implemented for Hazards that were identified as part of the Tasks that will be conducted as part of this Project.

B1–Chemical–Ramboll personnel shall familiarize themselves with the appropriate health and safety responses for exposure to known on-site chemicals prior to beginning work at the site. Site-specific chemicals are not limited to known chemicals of concern present in environmental media. During the preparation of the site-specific HASP, Ramboll personnel shall also consider historical chemical use resulting in potential chemicals of concern, as well as any current chemical use (e.g., drums, cylinders, containers) or chemicals brought on-site to complete project work (e.g., laboratory chemicals, sample preservatives). Personnel shall include relevant Safety Data Sheets in the site-specific HASP and review Attachment A Hazardous Material Properties prior to work involving hazardous materials.

Ramboll personnel, contractors, subcontractors, and visitors shall wear appropriate personal protective equipment (PPE) while performing site activities based on the expected COCs and additional site hazards. At a minimum, equipment shall include safety glasses, steel-toed boots, and hard hats (when overhead work is being performed or when overhead hazards exist). Additional PPE requirements, addressing the site-specific hazards and chemicals of concern, will be outlined in the site-specific Health and Safety Plan (HASP).

Air monitoring may be performed to ensure on-site exposure levels are maintained below regulatory requirements. Air monitoring equipment, monitoring plan and controls shall be specified in the site-specific HASP.

Containers of unknown origin and/or unknown contents should not be opened by Ramboll personnel without approval from the Global Director of Health and Safety. For projects in which containers are present with unknown contents, consult the site/facility representative for additional information and, if appropriate, consider retaining a qualified waste management company for testing and identification.

For additional information, refer to Standard Practice Instruction 6–Hazard Communication. Consult with your local Health Safety and Security Coordinator (HSSC) for any personal air monitoring requirements.

B2–Dust/Particulates/Fumes–Working in the vicinity of operating equipment (e.g., drilling rigs, heavy machinery, excavating equipment, power tools) poses unique safety situations including generation of dusts, particulate and fumes.

When the surface is disturbed soil, dust, and other particulates (e.g., concrete dust) can be released to the air. Severe weather conditions can also generate or contribute to hazardous dust and particulate conditions. This presents a hazard to the breathing zone of Ramboll employees, subcontractors, facility personnel, and other bystanders. It can also present an off-site hazard if transport of the generated dust and/or particulates off the subject property is possible. The level of risk associated with dust and particulate exposure is generally tied to the level of contamination in the soil, however, soil to dust/particulate transfer is not easily predictable and typically requires on-site real time monitoring to establish baseline exposure values.

Depending upon the work to be done by Ramboll personnel, a preliminary site field survey may need to be performed prior to involvement in drilling and/or heavy equipment operations. In the pre-planning stage, the site geology, ground cover, and scope of work (i.e., methods of investigation) should be discussed with the PM, PIC, and any subcontractors. If operating equipment will be utilized, and dust/particulate generation is a potential hazard, subcontractors should be directed (in the subcontract) to be prepared to control this hazard with water spray, or other method (e.g., tenting). The site specific HASP should include clear directives to monitor breathing the zone and/or site perimeter conditions using approved monitoring devices including, but not limited to personal air monitoring (PAM), dust meters, or perimeter monitoring with data logging equipment.

For additional information, refer to B18–Heavy Machinery, SPI 11–Trenching and Excavation Awareness, and SPI 37–Rigging and Material Lifting. Consult with your local HSSC for any additional requirements.

Both fuel operated equipment and volatile chemicals can present a fume hazard to Ramboll employees. Typically, when work is conducted outside, staff can anticipate that standard scopes of work and typically encountered constituents of concern will not present a fume hazard when best practices such as standing up wind are established and followed. However, there are scenarios in which Ramboll employees must be prepared to implement additional controls to address hazardous fumes. Certain work circumstances, specifically interior work conducted with gasoline-powered motors warrants evaluation for proper ventilation and monitoring to ensure sufficient oxygen and to avoid the buildup of harmful fumes (e.g., carbon monoxide, specific constituents of concern).

Prior to start of work, the scope of work and site-specific factors must be discussed with the PM, PIC, and/or local HSSC to ensure that the site-specific HASP includes appropriate controls to address the potential site-specific hazards. Regardless of the site-specific constituents of concern, oxygen must be maintained at a percentage ranging between 19.5 percent and 23.5 percent of the total ambient air. Ramboll personnel shall monitor the work area for oxygen deficiency hazards using monitoring devices that have been appropriately calibrated and are recommended for this specific use, as applicable. If direct air monitoring readings suggest an oxygen deficiency and/or the build-up of harmful substances, attempt to employ a passive corrective action such as moving the position of Ramboll personnel upwind of the hazardous area or equipment exhaust. If warranted, additional corrective engineering controls may include moving or removing the equipment, venting exhaust to the exterior of the building (typically if interior work is to be conducted, contractors need to be notified in advance that venting will be required), increasing work zone ventilation by opening overhead doors, utilizing fans or the facility ventilation system and/or upgrading PPE. If engineering controls do not adequately address the hazard, leave the area and contact the PM, PIC, and/or HSSC. Work will not continue until the hazardous fumes are properly addressed and safe work conditions are verified.

The presence of petroleum and solvent contaminated material presents a potential fire hazard. Smoking and use of open flame will be prohibited and the use of non-sparking tools and equipment will be required, if conditions warrant. Where the potential of fire exists, Ramboll will provide portable fire extinguishers and employees must be trained on proper use. All fire extinguishers shall be maintained as follows:

- Fully charged and in operable condition.
- Clean and free of defects.
- Readily accessible at all times.
- Be visually inspected each month and undergo a maintenance check each year.

Fire prevention and protection measures include elimination of ignition sources, where feasible, identification of combustion sources and atmospheres (e.g., Lower Explosive Limit [LEL] will be monitored), and early detection and rapid response to fire/explosion situations. In addition to standard operating procedures, the following safe work practices will be implemented:

- Site activities will comply with National Electric Code and explosion proof criteria.
- Smoking will not be permitted (or only in designated areas, if such areas are available). On sites where subcontractors are under the direction of Ramboll and fire/explosion hazards will be present, the subcontract shall state that smoking will not be permitted on-site and the Ramboll site supervisor shall enforce this requirement.
- Appropriate air monitoring will be conducted, when necessary.

- Welding activities will be monitored at all times..
- Solvents with a flash point of less than or equal to 100 degrees Fahrenheit will not be used for cleaning purposes.
- Fire extinguishers shall be kept in all work vehicles.

All fires and visible smoke that are detected at the site will be dealt with immediately by the individual recognizing the fire and/or smoke. In the event of visible smoke, fire or explosion, the following emergency response procedures will be implemented:

- Immediately cease operations.
- In all emergency fire situations, contact emergency services.

For small fires, personnel may attempt to extinguish the fire, if safe to do so and they have been trained. One fire extinguisher ONLY may be used to fight the fire. After one fire extinguisher is depleted, personnel must evacuate the area. For larger fires, perform immediate site evacuation.

For more information, please refer to SPI 3–Emergency Action Plan. Consult with your local HSSC for any additional requirements.

B3–Job Zone Control–Implementation of Ramboll scopes of work require that field personnel have a clear and organized plan prior to the start of work to control the chemical hazards of the job, ensure all contaminated materials (environmental media and otherwise) are contained and personnel, PPE, and/or equipment are appropriately decontaminated. Job zone control will vary depending on the level contamination and complexity of the project and site and may include but not limited to:

- A site map.
- Site preparation for project activities (e.g., making roads, establishing traffic patterns).
- Establish work zones (i.e., Exclusion Zone, Contamination Reduction Zone, and Support Zone).
- Use of the buddy system.
- Decontamination procedures.
- Site security (e.g., fences, locks, hired security).
- Communication plan.
- Safe work practices (e.g., good hygiene, avoid contact with contaminated media).

If the site investigation/remediation is being done at hazardous waste site, the PPE requirements will be forwarded as noted in the site-specific health and safety plan. Kneeling, lying in, or sitting on contaminated ground or materials must be avoided or a protective barrier must be used. Avoid or minimize handling of contaminated materials. Clean water will be kept available for decontamination, washing, and dust control. When water is required for decontamination, the necessity of containerizing and properly handling this water must also be evaluated. Consideration must also be given to decontamination of equipment such as drilling rigs, augers, and heavy equipment used for excavation/trenching. Subcontractors may need to include items such as decontamination pads and wash water containerization in the cost estimation stage; advance planning for job zone control is imperative.

The job zone control plan must be clearly outlined in the site-specific HASP and discussed in advance of start of work with all Ramboll project personnel, associated subcontractors, and site contacts, as appropriate. Consult with your local HSSC for any additional requirements.

B4–Heat–Heat stress can be a significant hazard, especially for workers wearing protective clothing. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim and in the prevention of heat stress incidents.

Workers will be encouraged to immediately report any heat-related problems that they experience or observe in fellow workers. Any worker exhibiting signs of heat stress and exhaustion should be made to rest in a cool location and drink plenty of water. Emergency help by a medical professional is required immediately for anyone exhibiting symptoms of heat stroke, such as red, dry skin, confusion, delirium, or unconsciousness. Heat stroke is a life threatening condition that must be treated immediately by competent medical authority.

The following American Conference of Governmental and Industrial Hygienists (ACGIH) screening criteria table shows heat stress exposure in degrees Celsius for an 8 hour work day, 5 days per week with conventional breaks will be used in determining safe exposure for acclimatized (adapted to site-specific environmental conditions) and unacclimatized (not adapted to site-specific environmental conditions) employees. Please note that at elevated temperatures, the ability to safely complete heavy or very heavy work is very limited and frequent rest breaks are required. The project schedule and budget should account for additional staff and/or a longer timeline to completion.

Allocation of Work in a Work/Rest Cycle	Acclimatized				Action Limit (Unacclimatized)			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	31.0 (87.8F)	28.0 (82.4F)	--	--	28.0 (82.4F)	25.0 (77F)	--	--
50-75%	31.0 (87.8F)	29.0 (84.2F)	27.5 (81.5)	--	28.5 (83.3F)	26.0 (78.8F)	24.0 75.2F)	--
25-50%	32.0 (89.6F)	30.0 (86F)	29.0 (84.2F)	28.0 (82.4F)	29.5 (85.1F)	27.0 (80.6F)	25.5 (77.9)	24.5 (76.1F)
0-25%	32.5 (90.5F)	31.5 (88.7F)	30.5 (86.9F)	30.0 (86F)	30.0 (86F)	29.0 (84.2F)	28.0 (82.4F)	27.0 (80.6F)

Heat Stress Prevention

Whenever possible, or within the control of Ramboll, engineering controls should be utilized to protect workers from heat related hazards. For example, isolation from the heat source, ventilation such as open windows, fans or other methods of creating air flow and heat shielding such as awnings or umbrellas.

Appropriate work practices can also lessen the chances of heat related hazards as follows:

- Water intake should be about equal to the amount of sweat produced (i.e., drinking 5-7 ounces of water every 15-20 minutes). Electrolyte fluids may also be necessary.
- Whenever possible, gradual exposure to heat (i.e., acclimatization) is preferred to allow the body's internal temperature to actuate to the working conditions.
- Whenever possible, adjust the work schedule to reduce risk of heat stress. For example, postpone nonessential or heavier work to the cooler part of the day and perform work in the shade if portable.

- Rotate personnel to reduce the amount of time spent working in direct sun and heat. Work at sites where heat stress is a significant hazard should not be completed by Ramboll personnel working alone.
- Increase the number and/or duration of rest breaks, and whenever possible, rest break areas should be in a cool area as close to the work area as is feasible.

Wear appropriate PPE when necessary, such as thermally conditioned clothing, self-contained air conditioning in a backpack and plastic jackets/vests with pockets that can be filled with dry ice or ice. However, based on the type of work being done, where work is being performed or other required PPE, these options may be prohibited or make the use of this PPE impossible or impractical.

For more information, please refer to SPI 30–Heat Stress. For additional information on Heat Stress first aid, refer to Appendix D First Aid Guidance. Consult with your local HSSC for any additional requirements.

B5–Cold-The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds (wind chill), dampness, and cold water. One, or any combination of these factors, can cause cold-related hazards. Cold stress, including frostbite and hypothermia, can result in severe health effects.

A dangerous situation of rapid heat loss may arise for any individual exposed to high winds and cold temperatures. Major risk factors for cold-related stresses include:

- Wearing inadequate or wet clothing thus increasing the effects of cold on the body.
- Taking certain drugs or medications such as alcohol, nicotine, caffeine and medication thus inhibiting the body's response to the cold and/or impairing judgment.
- Having a cold or certain diseases, such as diabetes, heart, vascular and thyroid problems, and thereby increasing susceptibility to the winter elements.
- Lower body-fat composition or other physiological differences. Statistics show that men experience far greater death rates due to cold exposure than women, potentially attributable to participation in risk-taking activities, lower body-fat composition and/or other physiological differences.
- Becoming exhausted or immobilized, especially due to injury or entrapment, thus speeding up the effects of cold weather.
- Advanced age. The elderly is more vulnerable to the effects of harsh winter weather.

The following table provides the resulting equivalent chill temperature to exposed skin as a consequence of increasing wind speeds at decreasing actual temperatures. Ramboll personnel shall be aware of predicted weather conditions before beginning site work and stay apprised of changes.

TABLE 2. Cooling Power or Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	4	−9	−24	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−121
25	30	16	0	−15	−29	−44	−59	−74	−88	−104	−118	−133
30	28	13	−2	−18	−33	−48	−65	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−98	−113	−129	−145
40	26	10	−6	−21	−37	−53	−69	−85	−100	−116	−132	−148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER. In < hr with dry skin. Maximum danger of false sense of security				INCREASING DANGER. Danger from freezing of exposed flesh within one minute.				GREAT DANGER. Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

*Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.
Equivalent chilll temperature requiring dry clothing to maintain core body tempearture above 36°C (96.8°F) per cold stress TLV

For more information, please refer to SPI 29–Cold Stress. For additional information on Cold Stress first aid refer to Appendix D First Aid Guidance. Consult with your local HSSC for any additional requirements.

B6–Severe Weather–Monitor the potential for severe weather in the days following the project. Severe weather conditions include but are not limited to high winds, electrical storms, and heavy rain, the highest hazard being lightning. When lightning is spotted, site personnel should seek shelter immediately, and use the following steps to avoid injury:

- Note the flash-boom ratio: count the time from the flash to the bang—for each 5 seconds between, the lightning is 1 mile away (activate lightning safety plan at count of 30 or 6 miles (9.6 kilometers) away) and don't resume activities for 30 minutes—its called the **30-30 rule**).
- If the storm is more than 6 miles (9.6 kilometers) away (greater than 30 seconds between lightning and thunder), the site supervisor should monitor the storm and be prepared to cease work if the storm becomes closer than the safe distance of 6 miles (9.6 kilometers). Since storms can travel at varying speeds, and the amount of time it takes to cease and secure operations will also vary, prudent judgment should be exercised when storms are in the vicinity and/or developing (e.g., darkening skies, increasing wind speeds, etc.).
- Regardless of travel distance to the storm, based on the flash-boom ratio, workers should not stay in exposed areas (on a roof, in an aerial lift, on a steel truss, on an ungrounded steel structure, in a golf cart, un-sided building, etc.) after lightning has been witnessed. All personnel must move to a safe, preferably interior, location.
- Workers should wait 30 minutes from the last sight of lightning or sound of thunder before returning to work.
- Those required to travel from one building to another during the 30 minute wait time should do so only by enclosed vehicle.
- Once the 30 minute wait time period has elapsed and no additional lightning or thunder has been seen or heard, individuals may resume normal work.

Here are some guidelines in preventing this electrifying hazard:

- Always monitor weather conditions, especially when going outdoors. Be prepared to shut down the job if thunderstorms are forecast.
- Keep an eye on the weather throughout the day. Stay tuned to the radio for updates on the weather.
- If lightning threatens, seek shelter indooors.
- If a storm is up and you are caught outdoors, seek the appropriate shelter. Here are examples of safe shelter sites:
  - substantial buildings
  - low ground — seek cover in clumps of bushes
  - fully enclosed metal vehicles with the windows rolled up
  - trees of uniform height
- The following are unsafe areas to seek shelter in:
  - electric/power poles
  - electrical equipment
  - heavy and road machinery
  - solitary trees
  - high ground and caves
  - water
  - open fields
  - all outdoor metal objects, like gates and fences
  - high mast light poles
  - metal bleachers
- If you feel your hair standing on end, and/or hear “crackling noises”, you are in lightning’s electric field and it is close.
- If lightning is extremely close to you and you are caught outside without shelter, immediately remove baseball cap and other metal objects and place them away from you. Put your feet together, duck your head, and crouch down low in baseball catcher’s stance with hands on knees.
- Be cautious in following a thunderstorm as the lightning may not be over.
- If a co-worker gets struck by lightning, administer first aid immediately. Remember that it is safe to touch them as they do not carry an electric charge. Seek medical assistance immediately.

For more information about severe weather systems not described herein, please refer to SPI 3-Emergency Action Plan. Consult with your local HSSC for any additional requirements.

B7–Safe Walking Surfaces and Work Areas–Hazards from floor and wall openings, careless movements, protruding objects, debris, spills, placement of materials on paths or foot traffic areas, present a problem with regards to slips, trips, falls and injury. When possible, prior to site work, evaluate site ground conditions and identify areas where an increased risk of slips, trip or falls may exist. If

conditions warrant, consider distinguishing a safe work path or establishing road/walk ways on longer term projects.

Ramboll personnel shall minimize the risk of slips, trips and falls by establishing general good housekeeping in work areas at all times including, but not limited to keeping the work area clear of excess equipment and cleaning up wet surfaces as soon as possible. In addition, the floor of every workroom shall be maintained in a clean and, as much as possible, a dry condition. Employees should avoid walking on wet and/or cluttered surfaces and be conscious of the fact the wet surfaces could be slippery and have the potential to cause injury. Spilled materials should be cleaned up immediately.

Personnel should stay alert at all times and, if tired or distracted, take this into account when working at the site. To minimize the possibility of injury:

- Wear sturdy, steel-toed work boots with good tread.
- Do not run.
- Slide feet when walking on slick/wet surfaces.
- Do not walk up or down steep embankments/hills, if possible. If not possible, walk at an angle when going up/down embankments/hills.
- Do not carry items that block your vision.
- Use handrails/grips when available and maintain 3-point contact whenever possible.
- Do not jump down from equipment. Look down before you step down.
- Report any floor openings that are not clearly marked and/or guarded.
- Keep paths and work areas clear of tools, equipment, boxes, cords, etc. Tape or secure cords, wires, etc. to minimize trip/fall hazard.
- If a protruding object cannot be moved, make sure the object can be easily seen or guard/pad the object, if possible.
- Use ancillary lighting, such as flashlights and headband lights, when necessary.

Sufficient lighting should be provided in all areas at all times. Employees should notify the responsible person of conditions where there is an absence of sufficient natural and/or permanent artificial light.

Emergency exit doors will be kept free of obstacles at all times. Any employee finding an emergency door blocked should immediately report the condition and correct it if possible. Exit lights and signs will also be maintained in proper condition at all times and immediately reported if deficient.

For more information about physical hazards, please refer to SPI 26–Slips, Trips and Falls. Consult with your local HSSC for any additional requirements.

B8–Noise–Hearing protection will be worn by all personnel working within the vicinity of equipment where noise is sufficient to interfere with general conversation at a normal speaking volume, when continuous noise levels exceed 85 A-weighted decibels (dBA), impulse noise levels exceeds 140 dB, and/or when the manufacturers' requirements indicate that hearing protection is mandatory. Personal hearing protection, such as earplugs or earmuffs, may be used to reduce the amount of noise exposure while the above control measures are being evaluated or if such controls fail to reduce the exposure levels to below the PELs.

HPDs (hearing protective devices) may be used to reduce the amount of noise exposure while control measures are being evaluated or if controls fail to reduce the exposure levels to below 85 dBA. The use of HPDs is mandatory for Ramboll employees whose 8-hour TWA noise exposure exceeds 85 dBA. Other

employees may also voluntarily wear HPDs, as long as their use does not interfere with the safe performance of on the job duties.

HPDs can prevent significant hearing loss, but only if they are used properly and the correct device is chosen. This can be difficult when personnel work in a different environment for each project. When evaluating the need for hearing protection, consider the sources of noise that will be present on the project, your proximity to those sources, and the duration of your exposure. If the exact source(s) of noise are known, you can consult the manufacturer (or internet) for an accurate dBA. Conversely, example sound levels can be researched on the internet for common types of machinery and ALWAYS use conservative professional judgment.

Each type of HPD has a noise reduction rating (NRR), found on its packaging, which is the measure, in dB, of how well a hearing protector reduces noise. The higher the number, the greater the noise reduction.

Ramboll uses the following method to assess the hearing protector's adequacy:

- Obtain the employee's noise exposure A-weighted TWA, when possible, or use an estimate
- Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector
- For example, if an earplug has an NRR of 26 and the 8-hour TWA is 100 dBA, the exposure would be 100-(26-7) = 81 dBA. Thus, this type of earplug, if worn properly, should provide adequate protection

Also, when dual protectors are used, the combined NRR provides approximately 5 dB more protection than the higher rated of the two products. For example, using ear plugs (NRR of 29 dB) with ear muffs (NRR 27 dB) would provide a NRR of 34 dB

(Earplugs NNR 29) + 5 = 34 dB (the combined NRR)

There are three types of HPDs:

1. Ear plugs, the most popular HPD, which are inserted into the ear canal to provide a tight seal against the canal walls to keep out excess noise

1. Ear bands, which rest outside the ear canal and provide a seal to keep out excess noise
2. Ear muffs, which enclose the entire ear inside rigid cups and the inside of the muff cup is lined with acoustic foam

Multiple types of earplugs and ear muffs should be provided to employees and the appropriate pair selected to control the noise hazards they may experience in the field.

Hearing protection should be worn when working within 25 feet of operating heavy equipment (drilling rigs, earth working equipment, etc.) as working around this type of equipment can result in exposure to hazardous levels of noise (levels greater than 90 dBA).

For more information about acoustical hazards, please refer to SPI 8–Occupational Noise Exposure. Consult with your local HSSC for any additional requirements.

B9–Unexploded Ordinances–Some sites (e.g., mines, firing ranges, former military-owned/operated sites, ordinance manufacturing facilities, etc.) may have old explosives, blasting caps, or other types of unexploded ordinances stored on site (e.g., in mines, in structures surrounding the mine or buried on site). Individuals must take immediate action in the event of finding and/or suspecting that explosives may be present. These actions include, but are not limited to, not touching or disturbing suspected explosives or making loud noises in their immediate vicinity. Slowly retreat from the area and

immediately report to the PIC/PM, local HSSC and Corporate Health and Safety Director so that ordinance experts can be contacted.

B10–Closed/Abandoned Mines–Project work conducted on former mining sites presents a higher level of risk to Ramboll personnel. The underground mine and associated buildings and equipment may not have been maintained over the years. The structural soundness of the mine, buildings and equipment may be compromised and could collapse. Mining sites are often in remote and dangerous areas. Mining operations are often specifically controlled by an administration or group designated by the country-specific location of the site (i.e., Mine Safety and Health Administration in the US) andr have specific health and safety regulations they are accountable to meet. Additional training is typically required before Ramboll personnel are permitted to work at a mine site.

Personnel are to avoid all contact with mines, mine structures, and building supports without prior HS authorization. Personnel are not to venture into mines or perform work in any areas should they appear structurally unstable. These conditions are to be immediately reported to the PC, Project HSSC, and Corporate Health and Safety Director.

B11–Operational Facility –Working in an operational facility requires that Ramboll establish a safe work perimeter and cordon work area to the extent that it is possible and appropriate. Creating this safe work area will protect Ramboll personnel and its subcontractors from traffic and hazards created in the operating environment and, in turn, protect facility employees or other observers, pedestrians, vehicles, adjacent property owners, etc. from hazards created by Ramboll activities. Prior to start of work, Ramboll personnel shall discuss this safe work area with the operational facility representative(s) in coordination with any Ramboll subcontractors. Consideration for potential hazards including forklift traffic, pedestrian traffic, overhead and/or underground hazards, dust and/or fume generation, at a minimum, shall be discussed. If traffic control is required beyond cones, signage, and temporary fencing, etc., and the facility cannot provide in-house traffic control, Ramboll shall consider contracting with a traffic control contractor and/or conducting work during off-hours.

Working in an operational facility requires that Ramboll establish a safe work perimeter and cordon work area to the extent that it is possible and appropriate. Creating this safe work area will protect Ramboll personnel and its subcontractors from traffic and hazards created in the operating environment and, in turn, protect facility employees or other bystanders from hazards created by Ramboll activities. Prior to start of work, Ramboll personnel shall discuss this safe work area with the operational facility representative(s) in coordination with any Ramboll subcontractors. Considerations including forklift traffic, pedestrian traffic, overhead and/or underground hazards, dust and/or fume generation, at a minimum, shall be discussed. Consider the use of cones, signage, and temporary fencing, etc. If conditions warrant, and the facility cannot provide in-house traffic control, Ramboll shall consider contracting with a traffic control contractor. Depending on the operations conducted by the facility, and the investigation required by Ramboll, it may be necessary to consider modifying work hours to early morning, overnight, weekend, or some other time where facility operations can be modified.

For additional information, refer to B18–Heavy Machinery, SPI 11–Trenching and Excavation Awareness, SPI 27 Subsurface and Overhead Clearance, SPI 33–Tool and Equipment Safety and SPI 37–Rigging and Material Lifting. Consult with your local HSSC for any additional requirements.

B12–Radiation–The two broad categories of radiation–non-ionizing and ionizing–are distinguished by the frequency, low and high, respectively. Non-ionizing radiation is commonly encountered, is low frequency and is typically benign (e.g., radio waves, microwaves, infrared radiation). Non-ionizing radiation also encompasses lasers and the visible light spectrum. In general, neither hazard evaluation nor controls are typically needed when conducting work where non-ionizing radiation is present. However, in a commercial/industrial occupational setting, non-ionizing radiation can present significant

hazards without proper controls. Each work site presents unique hazards and as such should be evaluated for any necessary controls. At a minimum, PPE shall include appropriate eye and skin protection.

Ionizing radiation includes the higher frequency radiation classes including ultraviolet, x-ray, and gamma rays. Chronic or acute exposure to ionizing radiation can cause injury under certain circumstances and hazard evaluation is required. While there is no level of ionizing radiation that is considered “safe”, health professionals generally agree on limiting a person's exposure beyond background radiation to about 100 millirem (mrem) per year from all sources. Exceptions are occupational, medical or accidental exposures. Medical X-rays generally deliver less than 10 mrem.

Work on projects involving ionizing radiation exposure requires approval from the HS department, additional radiation training and the development or participation in an exposure monitoring program. Contact the HS Director for additional information.

B13–Confined Spaces–With the exception of Ramboll’s wastewater treatment operations, Ramboll does not have confined spaces on its premises. However, sites that are visited by Ramboll or its subcontractors could possibly have confined spaces and, as such, must obtain, and review confined-space information from the host facility.

In general, Ramboll employees are not permitted to enter a confined space, or perform work in a confined space that would create a hazard, and make it a permit-required confined space. If Ramboll personnel are asked by a client to enter a confined space, Ramboll management must be informed, and be contacted for prior authorization.

To be a "confined space", **all** of the following must be met:

- The space is large enough, and configured such that a person can bodily enter, and perform assigned work,
- The space has limited or restricted means for entry or exit, and
- The space is not designed for continuous occupancy.

Permit-required confined spaces. To be a "permit-required confined space", the space must first meet all of the definitions given above, and present one or more of the following conditions:

- Contains or has a potential to contain a hazardous atmosphere,
- Contains a material that could engulf an entrant (person entering the space),
- Is configured such that an entrant could be trapped or asphyxiated by inwardly converging walls or floors, or
- Contains any other recognized serious safety or health hazard.

Ramboll’s health and safety policy prohibits unauthorized entry of site and facility employees into confined spaces.

Prior to entering a confined space, Ramboll employees (or its subcontractor's employees) need additional training. Without Confined Space training, entry into confined spaces is prohibited. In addition, entry authorization will only be given after Ramboll management has reviewed the nature of the confined space, the hazards present, and the measures needed to ensure safety. Under these circumstances, Ramboll will work with the host facility to determine training requirements, sampling requirements, written program requirements, and equipment needed to safely enter the confined space. Ramboll shall develop a standardized training format to meet the requirement for a safe confined space entry, as applicable.

Ramboll personnel should prevent unknowing entry into confined spaces through heightened awareness when assessing new or unfamiliar facilities and job tasks. Some common structures personnel may encounter in the field that *may* trigger confined space entry requirements include crawl spaces, ditches, trenches/excavations, underground equipment rooms or vaults and other industrial equipment spaces. Early identification of potential confined space issues allows the project team and the HS department to assess the hazards and implement the appropriate controls prior to the start of work activities. If you are unsure if a space at your worksite triggers confined space requirements, contact your PM, HSSC and the HS department for addition assistance.

For more information, please refer to SPI 10–Confined Space Awareness. Consult with your local HSSC for any additional requirements.

B14–Live Electrical Equipment–Electricity may pose a particular hazard to site workers due to the need to supply power to operate a newly installed system (e.g., remediation system) or the ongoing operations at the job site (e.g., electrically powered pumps/sampling devices, electrically generated lighting)). If wiring or other electrical work is needed in order to complete a Ramboll project scope of work, a qualified, licensed electrician must perform it.

In advance of starting work, it is important to understand the environment where work will be performed to ensure that work can be conducted safely. Depending on the environment, electrical equipment may need to be labeled as inherently safe and/or grounded in a specific manner. Consult with facility personnel for any site-specific directives.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.
- All portable generators or other portable internal combustion type devices used on site will be grounded. All grounds will be validated twice daily with a multimeter to confirm a resistance of less than ten ohms.
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or United States Coast Guard regulations.
- Portable and semi-portable tools and equipment must be grounded by a multiconductor cord having an identified grounding conductor and a multicontact polarized plug-in receptacle.
- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double-insulated tools must be distinctly marked and listed by UL or FM.
- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them.
- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.
- All circuits must be protected from overload.
- Temporary power lines, switchboxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage.
- Plugs and receptacles must be kept out of water unless constructed for submersion.
- All extension cord outlets must be equipped with ground-fault-circuit interrupters (GFCIs), if possible.
- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment.

- Extension cords or cables must be inspected prior to each use and replaced if worn or damaged.
- Cords and cables must not be fastened with staples, hung from nails or suspended by bare wire.
- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

In the event that a live electrical hazard presents the potential for fire, Ramboll will provide portable fire extinguishers and employees shall be trained on proper use. All fire extinguishers shall be maintained as follows:

- Fully charged and in operable condition.
- Clean and free of defects.
- Readily accessible at all times.
- Be visually inspected each month and undergo a maintenance check each year.

Fire prevention and protection measures include elimination of ignition sources, where feasible, identification of combustion sources and atmospheres, and early detection and rapid response to fire/explosion situations. In addition to standard operating procedures, the following safe work practices will be implemented:

- Site activities will comply with National Electric Code and explosion proof criteria.
- Smoking will not be permitted (or only in designated areas, if available). On sites where subcontractors are under the direction of Ramboll and fire/explosion hazards will be present, the subcontract shall state that smoking will not be permitted on-site and the Ramboll site supervisor shall enforce this requirement.
- Appropriate air monitoring will be conducted, when necessary.
- Welding, open flame or spark-producing operations will not be allowed on-site.
- Solvents with a flash point of less than or equal to 100 degrees Fahrenheit will not be used for cleaning purposes.
- Fire extinguishers shall be kept in all work vehicles

All fires and visible smoke that are detected at the site will be dealt with immediately by the individual recognizing the fire and/or smoke. In the event of visible smoke, fire or explosion, the following emergency response procedures will be implemented:

- Immediately cease operations.
- In all emergency fire situations, contact emergency services.

For small fires, personnel may attempt to extinguish the fire, if safe to do so and they have been trained. One fire extinguisher ONLY may be used to fight the fire. After one fire extinguisher is depleted, personnel must evacuate the area. For larger fires, perform immediate site evacuation.

For more information, please refer to SPI 3–Emergency Action Plan and SPI 9–Electrical Safety. Consult with your local HSSC for any additional requirements.

B15–Overhead Hazards-Work in the vicinity of operating equipment (e.g., drill rigs, heavy machinery, excavating equipment, etc.), in the vicinity of structural features such as scaffolding, cranes/rigging, low overhead clearance, and in unstable environments with falling debris presents overhead safety hazards. Ramboll personnel shall evaluate the presence of overhead hazards prior to the start of work and ensure that appropriate controls are put in place to protect site personnel including, but not limited to PPE (i.e.,

hard hats). As circumstances may change after work begins, Ramboll personnel should be aware that site controls to address overhead hazards may need to change as well.

When conducting work around a scaffold, controls are required in addition to wearing hardhats. Personnel shall be provided with additional protection from falling hand tools, debris, and other small objects through the installation of toeboards, screens, or guardrail systems, or through the erection of debris nets, catch platforms, or canopy structures that contain or deflect the falling objects. When the falling objects are too large, heavy or massive to be contained or deflected by any of the above-listed measures, the employer shall place such potential falling objects away from the edge of the surface from which they could fall and shall secure those materials as necessary to prevent their falling.

When Ramboll is conducting work at an operational site and/or with the assistance of a subcontractor, these precautions and safety mechanisms must be discussed and established prior to the start of work and documented in the site-specific HASP.

B16–Work Near Railroads-In the event that work activities are required adjacent (within 25 feet) to a railroad track, the rail company must be contacted prior to the start of work and access provided. Access may require additional discussion, planning, fees and personnel. The health and safety procedures must be coordinated with the rail company.

If work activities are planned in the vicinity of a rail line (greater than 25 feet), the following procedures will be implemented:

- The hazards of working near railroad lines will be included in job briefings prior to commencing work and when the activity changes.
- Mounting, dismounting, or crossing over moving locomotives or cars is prohibited.
- Employees will be alert for the movement of cars, locomotives, or equipment at any time, in either direction, on any track and will remain at least 25 feet (8 meters) from the end of standing cars, equipment, or locomotives, except when proper protection is provided (e.g., a flagman is present or the track is taken out of service by the proper authority, prior to starting any work on or about the tracks).
- Employees will not take refuge under any car, equipment, or locomotive.

Please refer to SPI 33–Tool and Equipment Safety for additional information. Consult with your local HSSC for any additional requirements.

B17–Traffic Management–If Ramboll personnel are required to conduct work within an active public roadway, the appropriate entity–local, state, federal–responsible for the roadway must be contacted. Specialized permits may be required in addition to retention of specialized traffic management contractors. Various degrees of barrier protection may be required based on site-specific traffic conditions.

In addition to and in the absence of local traffic management requirements, Ramboll personnel will take the appropriate steps to protect the worksite from interference with traffic/pedestrians and vice versa. The following measures for safe coexistence of traffic and employees shall be considered:

- Alternative walkways where possible;
- Use of an air horn to alert drivers or other workers;
- Maintain good housekeeping and clean the areas as work is completes;
- Use the buddy system while performing work;

- Use a spotter for backing, tight maneuvers and equipment/tank/bin drop-offs;
- Use traffic control devices, field vehicles and barricades;
- Park all vehicles (with wheels in a safe direction away from fieldwork) to block traffic with a flashing yellow light. Also, park so that access to the vehicle is away from oncoming traffic while working;
- When parking a vehicle and equipment, utilize a 'first move forward' driving practice;
- Work in an upright position, facing traffic when possible;
- Make eye contact with vehicle drivers so that they can recognize your presence;
- Minimize work time in traffic through scheduling, and;
- Establish a 'stop work' hand signal.

If controls have been reviewed and upgraded but the situation with speeding vehicles is still unsatisfactory, request additional assistance from the local Police department.

Please refer to SPI 33–Tool and Equipment Safety for additional information. Consult with your local HSSC for any additional requirements.

B18-Heavy Machinery / Drilling Rigs–Working in the vicinity of operating equipment (e.g., drill rigs, heavy machinery, excavating equipment, power tools, pumps, etc.) poses unique safety situations such as high pressure hazards from hoses and pipes, overhead hazards, and material releases. Also, other hazards may be present such as falls from elevation, electrical contact and improper machine guarding. Ramboll personnel shall only operate equipment they are trained to operate and that is equipped with appropriate protection devices. For equipment operated by subcontractors, Ramboll personnel shall familiarize themselves with the equipment being utilized, and shall, at a minimum, know how to stop or turn off the equipment in the event of an emergency. Ramboll personnel do not operate drilling or other heavy equipment, however, it is every employee's responsibility to recognize safe, appropriate use and be familiar with all potential and/or existing hazards related to the use of operating equipment. In the event of unsafe work practices by facility personnel, subcontractors, and/or other Ramboll personnel, all Ramboll personnel have stop work authority for any unsafe operations.

Certain scopes of work conducted during Ramboll projects, require the use of heavy equipment (e.g., excavators, loaders, cranes, etc.) that must be subcontracted with a qualified subcontractor. Ramboll personnel should, under no circumstances, operate or ride on heavy equipment. Site personnel will don high visibility vests and maintain a safe distance of at least 20 feet (6.1 meters) from all heavy equipment in operation. If the equipment has a mast or an arm characteristic of a drill rig, crane, or excavator, a safe distance is approximately one and a half times the height of the equipment. If activities warrant closer proximities to operating equipment personnel will discuss this need and safe procedures for approach with the equipment operator in advance of the start of work. Prior to approach, personal shall make eye contact with the operator and ensure that the equipment is powered down, or at a minimum, in a resting position. A second Ramboll employee will stand watch to keep him/her out of the path of equipment while performing the required activity. Further, personnel shall keep a minimum distance of 3 feet from an open drill hole, excavation, mud pit, or any other opening. Ramboll personnel will not place tools, meters, etc. in a position that could create a fall, trip or slip hazard. As much as is possible, employees will work with the appropriate site personnel to ensure the area in the vicinity of the operating equipment is clean, orderly and free of slip, trip and fall hazards. The following procedures should be followed when heavy equipment is in use:

- Use common sense. Do no assume that the equipment operator is keeping track of your whereabouts. Never walk directly in back of, or to the side of, heavy equipment without advance

discussion and agreed upon procedures, the operator's knowledge, eye contact and acknowledgement.

- All heavy equipment must be shut down during refueling.
- Maintain visual contact of moving equipment at all times.
- Establish hand signal communication prior to the start of work in circumstances when verbal communication is difficult. This mode of communication should be discussed at the start of each work day during the health and safety tailgate meeting.
- All heavy equipment shall have backup alarms of some type.
- Use chains, hoist, straps, and any other equipment to safely aid in moving heavy materials.
- Be sure that no underground or overhead power lines, sewer lines, gas lines, or telephone lines, will present a hazard in the work area. Specifically note overhead hazards in the area where equipment will need to mobilize across the site from the site entrance to the work area.
- Restrict all non-essential people from of the work area. If observation by non-essential third parties (e.g., the client, facility personnel, stakeholders) is necessary, determine a safe zone outside the active work area and cordon the area in some manner.
- Prohibit loose-fitting clothing or loose long hair around moving machinery.
- Instruct equipment operators to report any abnormalities such as equipment failures, unusual odors, etc.
- Store tools in clean, secure areas so that they will not be damaged, lost or stolen.
- When an equipment operator must negotiate in tight quarters, request that the subcontractor provide a second person to ensure adequate clearance. Ramboll personnel shall not provide specific direction as to how to operate equipment–it is the responsibility of the subcontractor.
- All heavy equipment must be properly leveled and supported prior to use.
- When heavy equipment is utilized inside a building, precautions must be taken to ensure that there is appropriate ventilation and exhaust is vented to the outside.
- Heavy equipment and trucks will be operated in specific site control zones and marked traffic lanes.
- Materials, tools, or other objects will not be thrown, tossed or dropped. Always hand off or lower items as needed.

Employee Restrictions and Responsibilities

Under no circumstances will a Ramboll employee operate a heavy machinery, a portion thereof, or any other piece of contractor or facility equipment.

In addition, Ramboll personnel will not:

- Direct equipment operator to a work location, provide specific guidance to subcontractor with respect to the operation of the equipment, assist in the movement of equipment or participate in the movement or breaking down of any portion of the equipment.
- Climb on the equipment.
- Watch a subcontractor arc-weld.
- Smoke while at the work site.

- Refuel an engine while it is still running or hot, siphon gasoline or park near equipment exhaust.
- Wear loose fitting clothing or PPE near operating equipment.

B19-Trenching/Excavation–An excavation is any manmade cut, cavity, trench, or depression in the ground surface, formed by earth removal. A trench is narrow excavation (in relation to its length) made below the surface of the ground. The following safe operating guidelines apply to open trenches or excavations exceeding four (4) feet (1.3 meters) in depth **or** of any depth if unstable soil conditions exist.

Excavations and trenches present a heightened risk on Ramboll projects. In addition to the heavy equipment hazards discussed in control B18, trenches and excavation create hazards associated with confined spaces, dangerous gas build up, unstable soil conditions, water retention, etc. For these reasons, excavation and trenching work shall only be performed by competent contractors training in the health and safety requirement associated with this type of work, in accordance with corporate standards and local/region regulations. When excavation/trenching work in managed by Ramboll personnel under a direct subcontractor, additional health and safety planning should be performed in conjunction with the subcontractor to ensure all HS requirements are satisfied.

Regardless of the management of the excavation or trenching work, Ramboll personnel working on projects where this type of work is being performed shall have an awareness level of training on the topic and ensure best practices are followed, including but not limited to:

- Excavated materials will be stored and retained at least 2 feet (0.6 meters) from the edge of the excavation. This procedure must be observed even when excavation/trench entry will not occur. The location for staging soil shall be determined by Ramboll personnel, the subcontractor, and facility personnel, if applicable, in advance of the start of work.
- Trees, boulders, and other surface encumbrances that create a hazard will be removed or made safe before the start of work.
- Special precautions will be taken in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation.
- Except in hard rock, excavations below the level of the base of the footing of any foundation or retaining wall will not be permitted, unless the wall is underpinned and all other precautions have been taken to ensure the stability of the adjacent walls. Please consult directly with the project PM, PIC, local HSSC, and the Global Director of Health and Safety when planned excavations potentially threaten the integrity of any structures.
- Excavations will be inspected at least daily, or more often as conditions warrant, by a **competent person** (i.e., the subcontractor in coordinator with the Ramboll Site Supervisor) to ensure that changes in temperature, precipitation, shallow groundwater, overburden, nearby building weight, vibrations, or nearby equipment operation has not caused weakening of sides, faces and flows. Without proper training in confined space entry, Ramboll personnel shall not enter any excavation greater than four (4) feet (1.3 meters) in depth (or less if soil is deemed unstable by a competent person). In the event that a Ramboll employee is properly trained in confined space entry, and has project-specific approval from the Global Director of Health and Safety, prior to entry, the atmosphere of the excavation must be tested to ensure that an oxygen deficient or hazardous atmosphere does not exist. If, at any time, the concentration of any airborne contaminant exceeds one-half its permissible exposure limit (PEL), or other applicable occupational exposure limit (OEL), the airborne oxygen concentration is less than 19.5 percent, or explosivity exceeds ten percent of the lower explosive limit (LEL), personnel shall not be permitted to enter the excavation. Engineering controls or other hazard controls (i.e., upgraded PPE) shall be instituted to eliminate or control the hazard.

- Field personnel shall not enter any excavation, greater than 4 feet in depth, without specific direction, for any reason. If personnel fall into the excavation and require rescue, properly trained emergency personnel shall be contacted for support.
- Ramboll personnel shall not operate trenching or excavation equipment. However, prior to start of work, the subcontractors shall direct Ramboll staff to the emergency stop for all equipment.

Ramboll personnel directing subcontractors conducting trenching/excavation activities shall request, at the subcontracting stage, if possible, the following safe work practices:

- When mobile equipment is used or allowed adjacent to excavations, stop logs, or barricades will be installed. The grade will always be away from the excavation. Construction of such features shall be the responsibility of the subcontractor.
- A means of egress (ladder, ramps, stairways, etc.) shall be accessible at any location inside the excavation without requiring more than 25 feet (8.3 meters) of lateral travel distance.
- Dust conditions during excavation will be kept to a minimum. Wetting agents shall be used when appropriate.
- Diversion ditches, dikes, or other suitable means will be used to prevent water from entering an excavation and for drainage of the excavation. Construction of such features shall be the responsibility of the subcontractor.
- All excavations will be marked and protected at all times to ensure site personnel, visitors, or unauthorized personnel do not enter without permission or fall into the trench.
- Personnel will work in pairs when working around an excavation of 2 feet (0.6 meters) or more.

In the event of unsafe work practices by facility personnel, subcontractors, and/or other Ramboll personnel, all Ramboll personnel have stop work authority for any unsafe operations. For more information, please refer to SPI 11–Trenching and Excavation Awareness. Consult with your local HSSC for any additional requirements.

B20-Vehicle Use–Work areas and site conditions must be considered when designating and selecting a vehicle for use (i.e., rental or company-owned). The vehicle shall be maintained in safe working order as required by the manufacturer. This would include a routine preventive maintenance schedule for servicing and checking of safety-related equipment. Special consideration should be taken when weather conditions reduce the safety and visibility while driving. Appropriate measures should be taken while driving during inclement weather including snow, icy and/or wet conditions; high winds; hail, heavy rains; debris or other impairments to safe driving caused by natural weather.

Special-use vehicles (e.g., All-Terrain Vehicles (ATV), snowmobiles, etc.) are vehicles with a light engine or electric motor, other than construction equipment, and are not intended and/or allowed for highway use. These vehicles may not have seat belts and **do not** meet substantial roll over protection standards (ROPS).

When operating vehicles, the following general practices will be followed:

- All vehicles will be operated in accordance with the manufacturer's requirements and specifications.
- Drivers should use prudent judgment and proceed cautiously when driving on non-paved roads. If using a rental car, ensure that the rental agreement allows driving on non-paved roads.
- Drivers will adhere to all site, local and state traffic laws including, but not limited to use of a hands free device when speaking on a mobile phone. TEXTING WHILE DRIVING ANY VEHICLE IS STRICTLY PROHIBITED.

- Operators of special-use vehicles shall be trained by a competent person–senior Ramboll personnel or otherwise. At a minimum, the training will be hands-on and the operator shall demonstrate basic skills prior to the conclusion of the training exercise. All individuals are required meet all training aspects before vehicle operation. This training shall be documented with the local HSSC prior to the start of work.
- Vehicles shall remain on flat surfaces at all times and shall not be operated on slopes steeper than a 30 percent grade;
- Daily inspections of vehicles for safety and maintenance will be required (i.e., fluid leaks/levels, tire pressure, tire surfaces, lights, fuel levels, brakes, etc.).
- Speed limits shall be maintained relative to legal requirements, safe operating speeds for the vehicle and in compliance with any facility-specific directives.
- Make sure the engine is turned OFF before dismounting the vehicle.
- Avoid driving over any extreme obstacles (i.e. wood/logs, fences, boulders, etc.).
- Operation is limited to the daylight hours, if possible.
- Do not carry passengers.
- Slow down before coming to a stop.
- Shut engine down prior to refueling.
- Each driver will have a valid driver's license.

For more information, please refer to SPI 40–Driving Safety. Consult with your local HSSC for any additional requirements.

B21-Water On/Near Water–Certain scopes of work conducted during Ramboll projects, require work on, over, or near water. All personnel and visitors must wear a United States Coast Guard (USCG) approved personal floatation device (PFD), or location-specific equivalent, when near water (i.e., within 4 feet/1.22 meter), over water, wading in water or on any vessel, where the danger of drowning exists. This PFD must be properly secured to the wearer, free of all defects including rips, tears, stress, and fading, and be kept clean and free of excessive dirt and oil. Several factors are relevant to determining whether a danger of drowning exists. These include the type of water body (i.e., a pool, a river, and a canal), depth, presence, or absence of a current, height above the water surface, the use of fall protection when working above a water body, and other site-specific/work-specific factors. Prior to the start of work, the contemplated scope of work shall be discussed with the PM, PIC, and local HSSC to determine appropriate controls.

Depending on the factors present, there are some circumstances where a drowning hazard could exist where workers are near or over water that is relatively shallow (i.e., less than 2 feet/0.6 meters) in depth. For example, where workers are not using fall protection and are 10 feet above a river, a worker may fall and be knocked unconscious. Without the use of a life jacket or buoyant work vest, a worker in such a scenario could drown.

A life ring equipped with 90 feet of solid braid polycarbonate line, or equivalent must be close to the working area and accessible for use. This includes activities on board all vessels.

USCG boating safety guidelines or equivalent should be adhered to when operating a boat during sampling activities. Boats must be equipped with the required running lights for night-time and/or, country-specific poor visibility conditions. Boats must be equipped with an anchor and alternate means of locomotion (e.g., extra motor, floatable oars).

All water work shall be performed by at least a two-person team. Both people shall be equipped with the proper safety gear and capable of readily summoning emergency rescue if needed. Ramboll personnel are prohibited from working in or near water by themselves.

At least one lifesaving rescue vessel (e.g., a skiff) shall be immediately available at locations where employees are working over, in, on or adjacent to water where the danger of drowning exists. The need to have a rescue vessel "immediately available" for use is dependant upon a number of factors, including but not limited to:

- The number of work locations operating;
- The distance to each of those locations;
- Water temperature;
- Currents, and;
- Other hazards such as, but not limited to, rapids, dams, and water intakes.

In general, if the water is so shallow that rescuers could simply run into the water body without endangering themselves and/or others or the work was being conducted very close to shore (e.g., the length of the skiff from shore would be greater than the working distance from shore and/or the skiff would foul on the bottom anyway), a skiff would not be required.

All work aboard a vessel shall be performed by at least a two-person team. If work is performed at times when water temperatures are less than 38°F (3-4C), it is recommended, but not mandatory, that sampling personnel wear float coats. The vessel should be operated only by designated, experienced staff.

For additional information, please refer to SPI 31–Water Safety. Consult with your local HSSC for any additional requirements.

B22–Working from Heights (Less than 4 feet (1.2m))–Fall protection is not required for work conducted at heights less than 4 feet above ground level. However, when the potential for work at varying heights exists, or the potential that implementation of the scope of work may increase the height at which work is being conducted (e.g., excavation/trenching), hazards associated with work at heights should be considered. Further, a mechanism for monitoring and documenting the potential changing conditions and a contingency plan for controlling potential hazards should be included in the site-specific HASP.

In the event that unanticipated conditions resulting in work at heights greater than 4 feet (1.2 m) are encountered during implementation of the scope of work, site work should be stopped immediately and the Ramboll Site Supervisor shall contact the project PM, PIC, and/or local HSSC.

Work up to four feet (1.2 meters) in height presents an increased risk of slips, trips, and falls and an increased severity of injury. Working off the back of a pick up or sport utility vehicle is a common low height situation encountered in the field. When ascending and descending a truck bed, dock or other raised structure implement best work practices like two-person teams and safe, deliberate movements.

For additional information, please refer to SPI 10–Fall Protection and SPI 26-Scaffolding. Consult with your local HSSC for any additional requirements.

B23–Working from Heights (Greater than 4 feet (1.2m)) increased risk is presented when Ramboll personnel work from heights greater than 4 feet (1.2m) and an increase awareness and frequent assessment of changing work conditions is expected. Work from height greater than six feet (1.8m) requires additional fall protection requirements, potentially fall prevention devices and PPE, and additional

HS training. Since the height of the work required for many projects may vary (e.g., work near and around excavations), Ramboll personnel must evaluate the need to fall protection controls when work is conducted at heights greater than 4 feet (1.2m).

The best fall protection control is to eliminate the hazard through the use of engineering controls or modification of the scope of work. However, at times hazards are identified during the course of project work or develop as a result of changing site conditions. If dangerous or unexpected work conditions are identified, site work should be stopped immediately and the Ramboll Site Supervisor shall contact the project PM, PIC, and/or local HSSC and the appropriate controls shall be implemented before work begins again.

In general, due to the tasks included in the scope of work, the hazards associated with working at heights can be anticipated in advance and depending on the objectives of the work, cannot be avoided. Hazard controls shall be documented in the site-specific HASP. At a minimum, the HASP shall include the hazards and risks associated with working at heights and control methods and will detail the required steps for protecting employees from fall hazards. Fall protection includes but is not limited to personal fall arrest systems consisting of a full body harness, a lifeline, and an attachment point. HS department notification and additional training is required for job tasks that involve fall protection equipment (i.e., body harness and lifeline, etc.).

Ramboll will provide training to ensure that the purpose, function, and proper use of fall protection is understood by employees and that the knowledge and skills required for the safe application, and usage is acquired by employees. Training will be conducted prior to job assignment and will include, as a minimum the types of fall protection equipment appropriate for use; recognition of applicable fall hazards associated with the work location and the work to be completed; and load determination and balancing requirements. All other employees whose work operations are or may be in an area where fall protection devices may be utilized, will be instructed to an awareness level concerning hazards associated with fall protection operations.

For additional information, please refer to SPI 10–Fall Protection and SPI 26-Scaffolding. Consult with your local HSSC for any additional requirements.

B24–Overhead/Underground Utilities–Various forms of underground and overhead utility lines, pipes (carrying water, wastewater, gas, electricity, and/or communication lines), or other hazards may be encountered during work activities. Every effort shall be made to locate and mark underground utilities, pipes, and other hazards prior to the start of intrusive work. Intrusive work includes any work activity where the work surface is penetrated at a depth greater than 6 inches (15.2 centimeters). At a minimum, Ramboll will conduct a historical site review to develop a plot plan with the most up to date utility information, contact the appropriate One Call service (where available), contract a private utility locating service (where available [REQUIRED IN THE US]), and clear the critical zone around any intrusive location to 5 feet (1.3 meters) in every direction. The measures described herein are required for interior work as well, including, but not limited to sub-slab soil gas probe installation. It is imperative, prior to any utility locating activities conducted by Ramboll personnel and/or a subcontractor, that the geology, surface covering (e.g., asphalt, concrete), and other potential interfering factors such as reinforced flooring, the presence of metal in the subsurface are identified and understood. This information must be transmitted to the private locating service in advance of start of work and preferably during the contracting phase so that appropriate locating equipment is selected.

As line voltage increases, your safe working distance will also increase. If overhead lines are present, call the utility company and find out what voltage is on the lines so the safe working distance can be calculated, or stay at least 28 feet (9m) from cables supported on wooden poles, and 50 feet (15m) from cables supported on metal poles. Work involving machinery with high extensions (drill rigs, backhoes,

etc.) will remain at least 10 feet (3.3 meters) from overhead power lines or further depending on the voltage of the line.

Should any operations cause equipment to come into contact with utility lines, the appropriate authority will be notified immediately and an Incident Report consistent with SPI 19–Incident Reporting will be completed. Work will be suspended until the appropriate actions for the particular situation can be taken.

Please reference Section 6 of the site-specific HASP and SPI 27–Subsurface Clearance for additional information. Consult with your local HSSC for any additional requirements.

B25–Electrically Powered Equipment and Tools–Many Ramboll scopes of work require that Ramboll personnel and/or its subcontractors utilize electrically powered equipment and tools. In order to use this equipment safely, ensure that all electrical equipment is properly grounded prior to use. Avoid standing in water when operating electrical equipment. Ground fault outlets or adapters shall be used for any electrical equipment, if possible. Apparatus, tools, equipment, and machinery will not be repaired while in operation; lockout/tagout (LOTO) procedures will be implemented when necessary (See B28–LOTO).

Tools can be hazardous when improperly used since these types of tools utilize energy in the form of electricity, liquid fuel, hydraulics, pneumatics, and/or powder-actuated. The following precautions will be taken by personnel to prevent injury:

- Power tools will always be operated within their design limitations, and only by employees who have been appropriately trained in the use, operation, and proper handling of such tools.
- Guards are not to be removed or rendered inoperative.
- Eye protection, gloves, and steel-toed safety footwear are required during operation. Refer to the equipment manuals for guidance and include this information in the site-specific HASP.
- Store tools in an appropriate dry location when not in use.
- Work only in well illuminated locations.
- If power tools will be used to penetrate a ground, parking, floor surface or other surface, Ramboll personnel must first evaluate the presence of underground utilities or obstructions.
- Tools will not be carried by the cord or hose and cords or hoses will not be yanked to disconnect from the power receptacle.
- Cords and hoses will be kept away from heat, oils and sharp edges or any other source that could result in damage.
- Tools will be disconnected when not in use, before servicing and when changing accessories such as blades, bits and cutters.
- Observers will be kept at a safe distance at all times from the work area.
- Tools will be maintained in a clean manner, and properly maintained in accordance with the manufacturer's guidelines. Pre-use inspection of hand and portable power tools should occur.
- Ensure that the work area is kept clean to maintain proper footing and good balance.
- Ensure that proper apparel is worn. Loose clothing, ties, or jewelry can become caught in moving parts.
- Tools that are damaged will be removed from service immediately and tagged "Do Not Use" until proper repair or disposal.

Please refer to SPI 9–Electrical Safety, SPI 33–Tool and Equipment Safety, and SPI 34–Equipment Grounding. Consult with your local HSSC for any additional requirements.

B26–Cutting Devices and Tools-Cutting devices are a type of hand tool that may frequently be encountered on Ramboll projects. The devices range from household scissors to box cutters and other sharp, exposed blades used to cut materials. Cutting devices should only be used by Ramboll personnel when it is an inherent part of their job task, like cutting open packing tape on a box that has been shipped to you for your project. For further example, cutting soil sample liners is a job task generally appointed to our drilling subcontractors and should not be performed by Ramboll personnel. If the use of a cutting device is required for a certain task, the safest device available that meets the needs of the job should be used. Safety cutting devices, like the "Klever Kutter" should be the first choice, when they are appropriate for the job. This device is designed to naturally shield the blade from the user. Some other guidance to consider:

- Always cut away from the body.
- Evaluate the need for work gloves or cut-resistant gloves during the planning stages of the project. Different types of gloves provide varying levels of protection that should be considered during the risk assessment. The materials used to make the gloves and the tensile strength of the weave determine exactly how much pressure can be applied before the fabric fails and cuts through. Usually the more protective gloves have less dexterity (or ease of movement) for the user, increasing other hazards in the process. A risk assessment should consider all these factors when evaluating PPE.

Please refer to SPI 33 –Tool and Equipment Safety for further information. Consult with your local HSSC for any additional requirements.

B27–Lifting Operations-Ramboll will ensure that all potential hazards regarding rigging and material lifting in our job sites are properly evaluated; however, Ramboll does not intend to provide employees with the knowledge/skill/ training to erect and/or dismantle rigging and/or material lifting equipment. The site-specific HASP should include provide documentation of the factors involved when rigging and material equipment is used by our direct subcontractors. In general, all scaffolds, rigging, and material lifting equipment must be erected and dismantled by a qualified and competent 3rd party contractor.

For lifting operations, even those conducted by a contractor, Ramboll personnel shall be aware of proper procedures and observe the following precautions:

- Store materials and equipment in designated areas to avoid creating additional hazards (e.g., block exits and/or unstable storage). Properly demarcate areas where materials and/or equipment may be placed, loaded or unloaded by adequate guarding and posting.
- Safely arrange materials and equipment to prevent tipping, falling, collapsing, rolling (i.e., properly stack, secure and/or stabilize items by interlocking, strapping or securing by an effective method to protect persons and property from potential injury and/or damage).
- Ensure that storage areas are kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage. Vegetation control must be exercised when necessary.
- Manual lifting and handling of material must be done by methods that ensure the safety of both the employee, the material, and the structure. Tag lines may be used to stabilize loads unless their use creates an unsafe condition.
- Personnel are prohibited from walking and/or working under loads that are about to be lifted and/or are suspended.

- Wear required personnel protective equipment as applicable, including, but not limited to a hard hat to protect against overhead hazards. See B15–Overhead Hazards for additional control information.

Please refer to SPI 37–Rigging and Material Lifting for further information. Consult with your local HSSC for any additional requirements.

B28–Lock Out/Tag Out (LOTO)-LOTO applies to the control of energy during servicing and/or maintenance of machines and equipment. In general, Ramboll personnel will not be authorized to perform LOTO job tasks unless additional training has been provided and employees are considered competent in that task. Where applicable, Ramboll will establish a program and utilize procedures for affixing appropriate LOTO devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start-up or release of stored energy in order to prevent injury to employees. Any LOTO procedure will be clearly identified and will be incorporated into the site-specific HASP. Ramboll will ensure that all equipment and machinery meeting the criteria for LOTO that are part of the work activities are evaluated, and that information and training programs, and LOTO procedures are implemented.

LOTO requirements do not apply to minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations if they are routine, repetitive, and integral to the use of the equipment for production. This exception is appropriate provided that the work is performed using alternative measures which provide effective protection in accordance with the site-specific HASP and equipment manual recommended procedures.

Please refer to SPI 20–Control of Hazardous Energy Sources (Lockout/Tagout) for further information. Consult with your local HSSC for any additional requirements.

B29 –Material Handling/Ergonomics–Lifting, carrying and lowering objects represent a potential physical hazard to Ramboll personnel. Therefore, it is every employee's responsibility to realistically evaluate the object to determine if the weight and size exceeds the employee's ability to lift, lower or carry it. To eliminate or minimize the risk of lifting hazards, utilize proper techniques, such as keeping the back straight and legs bent. Objects should always be lifted, lowered and carried as close to the body as possible. If the equipment cannot be lifted in this manner, it is too heavy to lift alone. Call other personnel, or use a mechanical device for aid in lifting. Mechanical aids, like hand trucks and carts, or the buddy system should be used to move heavy objects, objects with poor handgrips, or large bulky objects. Some other things to consider:

- Evaluate the object for the presence of any physical hazards such as pinch points, sharp or jagged edges, burrs or rough and slippery surfaces.
- The route in which the object will be moved should be free from obstructions, which could cause difficulty in moving the object.
- Asses other hazards such as stairs before you move the object and consider smaller loads with multiple trips as a safe alternative
- If an object is stored at a level higher than five feet, or on the floor, an appropriate mechanical device may be necessary to move the object.
- Recognized lifting hazards should be designed out of the work process whenever possible.
- Seek help when handling loads that are too bulky to grasp or lift, when employees cannot see around or over a load, or when they cannot safely handle a load for any other reason.
- Consider the use of PPE, such as gloves and forearm protection, when appropriate.

Proper lifting and lowering techniques should be followed even if the object or material to be lifted is of lighter weight. Keep the objects as close to the body as possible and:

- Establish a firm footing with feet at approximately shoulder width and one foot slightly ahead of the other. This posture will aid in keeping good balance and will establish a stable lifting base.
- Always bend at the knees, not at the waist when lifting or lowering an object.
- Obtain a good secure grip on the object.
- When beginning to lift, tighten your stomach muscles and use your legs to lift the object, as leg muscles are generally stronger than back muscles.
- Lift slowly and smoothly.
- If you need to turn as you lift, **do not twist** at the waist, but instead pivot with the feet. When lowering the object, reverse the procedure.
- When possible, conduct lifting activities over a period of time with adequate rest breaks. If material handling must take place over a short period of time, use mechanical means and/or the buddy system.

When it is necessary to move heavy and/or bulky objects, a non-powered hand truck should be used whenever possible. Some things to consider are:

- Keep the center of gravity of the load as low as possible, and place heavy objects below lighter ones.
- Place loads where the weight of the load will be carried by the axle, not the handles, and where it will not slip, shift of fall during movement.
- Load only to height to allow a clear view ahead. Only walk backwards with a hand truck in specific instances such as when going up an incline.
- When going down an incline the hand truck should be in front of the operator and when going up an incline, it should be downhill from the operator.
- Move the hand truck at a safe speed.

Please refer to SPI 44–Occupational Ergonomics for additional information. Consult with your local HSSC for any additional requirements.

B30–SIMOPS (Simultaneous Operations)-SIMOPS are one or more activities or work taking place at the same time, with the potential to affect one another. The operations must be occurring within significant proximity to each other that they create new or additional hazards. The Designated Site Supervisor will be responsible for determining when SIMOPS are present on a Ramboll work site and coordinating safe work for all activities.

SIMOPS shall be identified on the site-specific HASP/RA and appropriate mitigation/hazard controls shall be identified and implemented to eliminate or minimize risks through the hierarchy of controls:

- Eliminating SIMOPS via scheduling or permitting;
- Substituting work processes with less hazardous processes;
- Separating SIMOPS by distance, barricade, signage, isolation or engineering controls; and/or
- Implementing other controls such as training, communication, PPE and Stop Work authority.

Planning, scheduling, communication, and cooperation are essential for safe and effective SIMOPS on Ramboll work sites and should be documented in the site-specific HASP/RA. A communication plan should

be established between each work group to include coordination meetings prior to projects where multiple operations are scheduled and the appropriate response if an unexpected event occurs.

B31–Bloodborne Pathogens–In general, Ramboll must determine which employee(s) have a potential occupational exposure to bloodborne pathogens and establish an exposure control plan. Ramboll currently does not have employees that have a continuous potential for occupational exposures to bloodborne pathogens; however, during the implementation of Ramboll scopes of work, there is potential for injury and the potential for personnel to respond and all employees approved to conduct field work are required to complete first aid or country-equivalent training. Procedures in which a potential for occupational exposure may occur without regard to the use of PPE include, but are not limited to, basic first aid treatment and Cardio Pulmonary Resuscitation (CPR).

The best method for ensuring the health of the employees at risk is to understand and follow the concept of Universal Precautions. This concept refers to the assumption that all blood and bodily fluids are contaminated with pathogens. Universal Precautions shall be observed by all Ramboll personnel. Universal precautions shall be observed to prevent contact with blood or other potentially infectious materials. Under circumstances in which differentiation between body fluid types is difficult or impossible, all body fluids shall be considered potentially infectious materials.

Engineering and work practice controls shall be used to eliminate or minimize employee exposure. Where occupational exposure remains after institution of these controls, PPE shall also be used. Hand washing is a primary work practice control. If this is not available or feasible, then alternative methods, such as antiseptic hand cleaners, in conjunction with clean cloths or paper towels, or antiseptic towels will be provided. When these alternative methods are used, employees shall wash their hands (or other affected areas) with soap and running water as soon as feasible thereafter. Ramboll will provide hand washing facilities or alternative methods which will be readily accessible to employees. Additional considerations include the following:

- Eating, drinking, smoking, etc. are prohibited in first-aid and restroom areas where there is reasonable likelihood of occupational exposure.
- Employees should don appropriate personal protective equipment prior to performing any first aid to ensure that they will not contact blood. Each office will maintain the appropriate personal protective equipment with the first aid supplies. This equipment should include impervious gloves and mouth shields. Gloves worn should be compatible with cleaning and disinfection solutions used.

In any circumstance where there is a potential exposure to bloodborne pathogens by a Ramboll employee or its subcontractors, an Incident Report must be filed in a timely manner in accordance with SPI 19–Incident Reporting.

Please refer to SPI 4–Medical and First Aid Program and SPI 20–Bloodborne Pathogens for additional information. Consult with your local HSSC for any additional requirements.

B32 –Plants and Animals–Care will be taken by all site workers to avoid poisonous plants, animals, and/or stinging or biting insects such as ticks, mosquitos, spiders, bees, wasps, hornets, and yellow jackets. Workers allergic to any particular plant, animal exposure, or insect sting or bite should notify the local HSSC and all site personnel (including facility and subcontractor personnel) prior to start of work. If stung, bitten, or otherwise exposed to an allergen, the affected person shall utilize emergency medicine, if prescribed by their doctor, and seek emergency support when appropriate.

The first step in controlling the risks presented by certain plants and animals is thorough field preparations, including but not limited to the following:

- Research local species that are present or active in your area

- Identify important information to aid in identification and plan for appropriate control mechanisms
- Document hazards in your field-specific project plan (i.e. HASP, HSP or RA) and communicate with field personnel
- Follow the hierarchy of controls to reduce risks, which we will discuss later in this lesson
- Identify first aid treatments and emergency protocols

Animals and insects that pose a threat to human safety vary greatly by region and local environment. Furthermore, the level of threat they pose varies greatly by species and situation. Some animals only pose nuisance threats while others can be life threatening. Of those animals that can be harmful to humans, few will outright attack unless they feel threatened or are protecting their young. Therefore it is very important to evaluate each situation where animals can be encountered individually to assess the risk.

The hazards posed by poisonous plants are different because plants are stationary. Once properly identified, harmful species can typically be removed or cornered off so personnel do not come into contact with them. But be cautious! If poisonous plants are identified in one area of the site, it's likely they may be in others as well.

Before you travel to a site to perform field work, perform your due diligence by identifying the plants and animals that may pose a threat in that particular area. This information can be conducted through internet research, but be sure to consider only reputable sources and cross-reference important information. Field guides from various sources, including Peterson and Oxford, provide valuable information on a wide variety of plant and animal hazards. Some guides are specific to a certain geographical location. These guides are a great resource for local staff; share them when possible! Finally, many local regional agencies supply information on dangerous plants and animals in their area.

Even though you may be familiar with the plants and animals in your area, you might not be as familiar with things in another region of your country, another country, or even another continent! So, when traveling to different areas for your projects it is prudent to consult with:

- Site contact (client, maintenance staff, etc.)
- Ramboll personnel who have previously been on-site
- Ramboll personnel who are local to the region
- Local and regional wildlife agencies
- Reputable field guides

Document important species-specific information to the site HASP/HSP/RA or other site-specific plan. Keeping track of this information will help everyone on the project to identify and control plant and animal hazards. It will also be useful as a quick guide in the event of a field encounter. Further, this information should be used during daily HS meetings to keep personnel aware and informed of site risks. Consider providing the following:

- Names of species
- Photographs of the animals/plants discussed
- Indicators of animal/plant presence
- Measures of what to do if animals/plants are encountered
- Controls and safe work practices, which will be discussed next

- First aid measures

Please refer to SPI 28–Plants and Animals for additional information. For species-specific information and first aid procedures, including information on tick removal and first aid, refer to Appendix D First Aid Guidance. In the event that first aid is required for any encounter with a poisonous plant, insect, or animal, an incident report, consistent with SPI 19–Incident Reporting, must be completed. Consult with your local HSSC for any additional requirements.

B33–Job Safety–If it is deemed that a work site is in an area where Ramboll personnel and/or the job site may be at risk from potential criminal acts, wild animals, etc. the risks will be evaluated and implementation of site-specific preventative measures will be taken to minimize the risk. Consideration shall also be given to security for equipment left on-site. For example, if Ramboll installed a remediation system on an isolated client site, it is prudent, at a minimum, to plan for site and equipment security with fencing and locking devices on any valves.

Informational resources such as the client, local law enforcement officials, Park or Wildlife Service, and Animal Control could be utilized to assess the risk and to ensure the safest possible work environment. For example, local law enforcement can be made present or make frequent patrols in the area while work is being done, outside security can be hired, and work can occur only during certain times of the day. It is also possible that after initial risk evaluation, the PM, PIC, local HSSC and/or the Global Director of Health and Safety may determine that work may not proceed at all.

B34–Personal Safety–If it is deemed that a work site is in an area where an employee's personal safety may be at risk from working in an isolated area, working early/late, or in areas of limited cell phone service, the risks will be evaluated and implementation of site-specific preventative measures will be taken to minimize the risk. Informational resources such as the client and local law enforcement officials, could be utilized to assess the risk and to ensure the safest possible work environment. For example, when working early/late, or in areas of limited cell phone service, local law enforcement can be made present or make frequent patrols in the area while work is being done or check in with on-site client representatives may be arranged. It is also possible that after initial risk evaluation, the PM, PIC, local HSSC and/or the Global Director of Health and Safety may determine that work may not proceed at all. Some general guidelines are provided here, but each situation is different and actions must be taken based on the specifics of each.

In areas of risk, employees will communicate via cell phones or 2-way radios, and will check-in at predetermined times throughout each workday. The communication schedule and the responsible parties shall be clearly documented in the site-specific HASP. See SPI 42 Working Alone for additional information.

B35-Working Alone–Further personal safety risk evaluation is warranted when working alone. Ramboll considers employees to be working alone when they cannot be seen or heard by another worker, and/or where assistance is not readily available in the event of an injury, illness or emergency. Whenever possible, employees will not work alone in isolated areas or under extreme conditions. If conducting high risk activities, such as confined space entry, electrical system work or work involving the use of respirators, work may not be performed alone. If the isolated area work involves hiking/walking into areas that are unmarked, or if there is potential to become directionally disoriented (e.g., no trails, unmarked trails, forested or highly vegetated areas), employees will be trained on the use of a compass and trail/topography maps. If necessary, Ramboll personnel will complete wilderness safety training. The employee will work with the Park/Wildlife service in advance to determine what emergency planning is necessary to prepare to complete the proposed scope of work including scenarios such as unexpected weather, animal attack, and search/rescue.

Communicating through cell phones or 2-Way Radios will be utilized whenever possible. Employees will check-in at predetermined times throughout each workday and if the risk rating increases, employees will check-in more frequently. If employees do not call in to the PM, or designated representative, the employee will be contacted. If contacting the employee is unsuccessful, the appropriate authorities will be notified. In addition, the planned start and estimated finish times for each work day will be communicated by the site supervisor to the PM, or designated representative, and employees will check in at the beginning and end of the work day. If employees will be moving from isolated area to isolated area, there will be established beginning and ending locations, planned start and estimated finish times, and planned routes that will be followed throughout the day. Employees will not deviate from this schedule without first contacting the appropriate personnel. It may also be necessary to notify the client, law enforcement, or Park/Wildlife officials of these schedules.

The communication schedule and the responsible parties shall be clearly documented in the site-specific HASP.

Please refer to SPI 42–Working Alone for additional information. Consult with your local HSSC for any additional requirements.

B36–Seasonal Hunting and Dangerous Wildlife–When planning to complete a scope of work in an isolated and/or wooded area, seasonal hunting hazards should be considered. Contact the client, local law enforcement, and/or Park/Wildlife officials to evaluate this risk. During recreational hunting seasons, field personnel will wear appropriate clothing, such as fluorescent orange high visibility vests, to enhance visibility to potential hunters and not blend in with the landscape. Field personnel should also use whistles, air horns and/or other means to make their presence known to hunters and wildlife alike. The schedule of the hunting season, if applicable, will be included as an addendum to the site-specific HASP in order to inform personnel of the type of game (e.g., deer, pheasant, duck, etc.) that is being hunted and the type of weapon being used (e.g., bow & arrow, shot gun, single shot rifle, etc.). Be aware that even if “No Trespassing” and/or “No Hunting Allowed” signs are posted, trespassers and/or hunting may still be on-going in the work area. At no point should field personnel or contractors confront trespassers.

Local authorities should be contacted about any hunting season that may be in session, and if it is possible that hunters may be present in the area in which Ramboll personnel will be working. If so, employees will wear brightly colored hardhats/hats and reflective vests, will not work before dawn. Work will end 30 minutes before dusk.

If you see wild animals while driving, stay in your vehicle. Never get out for a photo or a closer look. Keep windows up and do not try to keep the animal from crossing a road with your vehicle. If you see a wild animal while on foot, never approach the animal. If the animal has not seen you, go back the way you came. Do NOT turn your back and run which could evoke their natural predator instinct. Instead, keep facing the animal and back away at a steady pace. If you are near a car or building, get inside. In addition, in areas of higher risk (i.e., contacted officials have indicated that wild animals are a nuisance), employees may want to consider carrying “pepper spray”.

If, while on the project site, and despite any precautions set forth, if an employee feels that their personal safety is at risk, they shall cease work, leave the work area and immediately report their concerns to the project PM, PIC and local HSSC so that appropriate steps can be taken.

Please refer to SPI 28–Plants and Animals for additional information. Consult with your local HSSC for any additional requirements.

APPENDIX C

SUBSURFACE CLEARANCE FIELD CHECKLIST

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STANDARD PRACTICE INSTRUCTION 27

SUBSURFACE AND OVERHEAD CLEARANCE

RAMBOLL

STANDARD PRACTICE INSTRUCTION 27

IMPLEMENTATION DATE: April 2019

REVISION DATE: April 2022

SUBJECT: Subsurface and Overhead Clearance

BASIS: Intrusive site work is one of the most hazardous tasks that E&H employees undertake. Intercepting a utility presents an immediate danger to the health and safety of our employees, our contractors, and the surrounding community. This type of incident can be life threatening. Subsurface incidents can also cause property damage, trigger financial and legal repercussions, and damage our reputation with our client and the community. When the hazards are correctly identified prior to subsurface work, the risks associated with such hazards can be minimized. As such, no intrusive work is to be conducted by Ramboll personnel or Ramboll subcontractors until the hazards associated with the possible presence of underground and overhead services in and around the work area are identified and safe locations marked and agreed upon by site personnel and project team, as applicable. This Standard Practice Instruction (SPI) applies to intrusive site work including without limitation: test pit or trench excavations; borehole excavations using hand auger, shell and auger, rotary, hydraulic and percussive methods; gas spiking; manual excavations; hand digging; borings into vertical, indoor, or belowground surfaces; and/or, any other on-site activity where penetration of a surface is required.

GENERAL: The approach outlined in this SPI is designed to ensure the health, safety and welfare of Ramboll employees, contractors and others potentially affected by Ramboll's work. The aim of this SPI is to manage risk to the lowest practicable level, ensuring compliance with the relevant applicable legislation and Ramboll Policy.

RESPONSIBILITY: This SPI will be implemented when conducting intrusive work and where overhead lines are present, and will be supplemented (or superseded, if necessary) only if additional requirements (e.g., local, regional or country specific regulation, client requirements) do not prevent adequate evaluation of utilities. The Director of Health, Safety and Security ("Director of HSS") is solely responsible for all facets of this program and has full authority to make necessary decisions to ensure success of the program. The Director is the sole person authorized to amend these instructions. Nonetheless, all Ramboll employees are authorized to stop work and have the duty to halt any operation where there is danger of serious personal injury, property damage, and/or harm to the environment.

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EXECUTIVE SUMMARY

The intent of this executive summary is to identify the general tasks that must be performed to reduce the likelihood of encountering subsurface and overhead structures during intrusive activities. It is not a substitute for following the requirements identified in the remainder of this document. It is recognized that country specific procedures may slightly vary (e.g., commercial line location services may not be available in all geographical locations where Ramboll conducts operations). Nonetheless, the minimum subsurface and overhead clearance requirements that are to be followed are outlined below.

Contracting/Administration:

The Project Director shall define contractual and legal responsibilities associated with intrusive activities by utilizing a properly executed subcontract and proof of insurance, or its equivalent.

Project Planning:

1. **Gather site utility information** - Specific to both underground and overhead utilities. Review aerial photos, site maps, as-builts, figures, and other available sources.
2. **Identify a knowledgeable site representative** – Communicate the scope of work and locations and areas proposed for investigation; determine the right site representative. Ask for relevant utility information and feedback.
3. **Create a site-specific plot plan** – The plan must depict proposed intrusive locations, alternate locations, and known utilities based on the information gathered during the first two tasks.
4. **Actively plan with subcontractors** – Discuss with both drillers and private locators the ground surface, soil conditions, and any site-specific features that may create interference, as well as soft digging options. The locating contractors should ultimately determine the correct tool - for example, GPR or EM - for site conditions.
5. **Assess public utilities**– Either via One Call, 811, directly or via regional or national web services, confirm the presence or absence of commonly expected services. Where available, public utilities must be marked on the ground surface.

Field Implementation:

6. **Ensure that public utilities are identified** – Confirm that expected underground and overhead utilities, as documented on the pre-planning worksheet, are marked to the property boundary. If a utility is confirmed neither present nor absent, contact the utility owner to investigate further.
7. **Perform a site walk** – Walk the site with the private locator while they investigate. The locator must trace public utilities into our work areas and onto private property when applicable.
8. **Identify visual indicators** – With the private locator, investigate and trace to resolution any visual indicators of utilities or anomalies within the work areas.
9. **Clear intrusive locations** – Each intrusive location must be clear of potential underground utilities or unresolved anomalies to a 5-foot or 1.5-meter Critical Zone surrounding the location delineated by the private locator. A recommended percentage of pre-planned alternate locations should be cleared using the same process.
10. **Gain approval for all intrusive locations** – Before beginning intrusive work, communicate findings and updates back to the project team, facility representative, and client contact, as required. When available, include the knowledgeable site representative in the Site Walk and obtain sign-off on intrusive locations on the SSC checklist.

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ACRONYMS AND ABBREVIATIONS

CAT	Cable Avoidance Tool
GD	Ground Disturbance
HASP	Health and Safety Plan
HSS	Health and Safety
HSSC	Health, Safety and Security Coordinator
IA	Intrusive Activities
JSA	Job Safety Analysis
MP	Managing Principal
PD	Project Director
PM	Project Manager
PPE	Personal Protective Equipment
RA	Risk Assessment
SSC	Subsurface Clearance
SPI	Standard Practice Instruction

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DEFINITIONS

Critical Zone: The area bounded by a 5 foot (1.5 meter) radius extending horizontally from the intrusion point where subsurface objects may exist that if encountered could result in injuries, damaged equipment or property, or disruption of utility services.

See Figure 1 below for an example of a single intrusive location and the 5 foot (1.5 meter) Critical Zone around it that must be cleared.

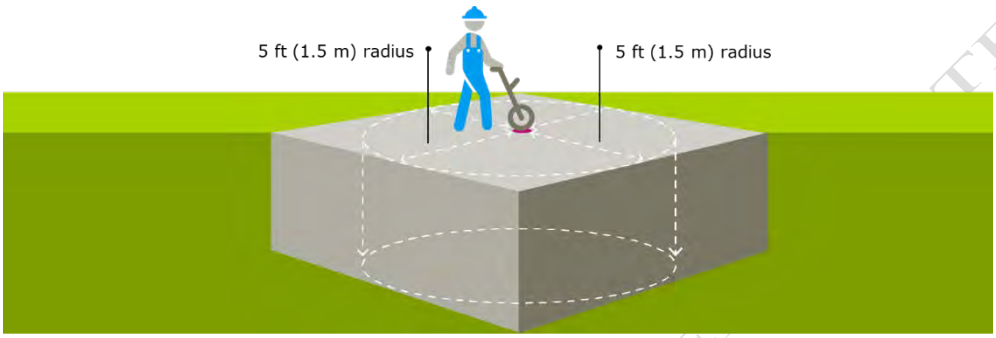

Figure 1:

The Critical Zone of 5 feet (1.5 meters) radius – both horizontally and vertically - from the Intrusion Point.

Clearance Site Supervisor: An employee assigned by the PM or PD that has sufficient professional or technical training, knowledge, experience and authority to implement the requirements in this SPI.

Designated Area Expert: An employee designated regionally with sufficient professional and technical training, knowledge, experience and authority to implement the requirements in this SPI and to review and authorize exemptions.

Dig/Drill Zone: The area of ground or surface to be disturbed during drilling or excavating.

Excavation: Any man-made cut, cavity, trench or depression in the earth's or other surface, formed or caused by earth or material removal.

Director of HSS: When used in this document, this term refers to the Global and European Directors of Health & Safety and/or their designated person.

High Risk Area: Exploration/excavation locations that require a higher level of precaution due to the increased level of danger and/or potential complexity of underground systems/services. Examples include: the edge of any tank/basin, pump islands, and/or pump galleries; areas containing electrical transformers, compressors, production wells, loading racks or other process equipment associated with underground utilities and/or structures, and; areas with the potential for unexploded ordinances.

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Ground Disturbance Point: The point on the ground surface where intrusive work will be performed. This may be a single point such as when using a hand augur or a large area where an excavator will remove the surface.

Intrusive Point: The point where intrusive work will be performed; this can include ground surfaces as well as building/structural surfaces.

Intrusive Activities (IA): Any indentation, interruption, intrusion, excavation, construction or other work activity that disturbs the surface of a building/structure material or the earth.

Line Location Organization: Commonly referred to as a "One Call," an organization that coordinates utility locating services with member utility companies. Line Location Organizations may not be located in all geographical regions and/or countries. Refer to your regional / country specific organizations for availability.

One Call: A commonly used term for a service that coordinates utility locating services (e.g., "One Call" system in North America, "Before You Dig" in Australia and UK). In other areas of the world, One Call may be a regional or national web service. These organizations do not perform the locating service themselves but rather contact the affected local utility companies, which will then mark where their utility lines are buried, but only on public property. In other regions, the service may provide public utility layouts to relevant parties. A summary of contact information for several One Call organizations is provided in Attachment C.

Plot Plan: A map of the site that reflects the known underground facilities, pipelines and/or utilities in the vicinity of the work areas, proposed ground disturbance and/or intrusive areas, and visual indicators of underground utilities present at the site. Map may be hand-drawn, on an existing site or pipeline plan, or computer generated as long as the distances and/or scale are reflected.

Search Zone: The parcel of land or definitive area where intrusive activities may be performed and which can be subject to locating of utilities.

Subsurface Clearance (SSC): Use of specialized equipment to locate subsurface structures and objects and mark them on a map and/or the surface in order to avoid them during intrusive work activities.

Sweep and Search: An electronic sweep of the Critical Zone or any other critical area using grid patterns and a locator capable of detecting buried objects. Note that some location equipment can only detect metallic objects; locators that can detect both metallic and non-metallic objects are required.

Ticket: A service or request made to a One Call organization. Ticket life must be valid for the term of the project.

Tolerance Zone: The tolerance zone is the width of an underground utility plus a specified tolerance distance on both sides of that utility; this zone varies based on utility company requirements and/or local, city, county, State, and/or country specific regulations. Under NO circumstances are powered-digging equipment to be used within this zone.

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Unobstructed Intrusive Locations: A series of locations in close physical proximity and unobstructed by an edifice(s) so that Designated Person can accurately infer the connectedness of the underground utilities in that area. For example, if ground disturbance points surround a large building on site and public utilities are also present, it would be prudent to perform SSC Checks for each unobstructed group of points.

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1. OVERVIEW

Ramboll will review and evaluate this SPI on a triennial basis or when changes or incidents occur that prompt revision of this document. Effective implementation of this program requires support from all levels of Ramboll management within Ramboll and communication of its requirements to affected personnel.

2. SCOPE

The purpose of this Subsurface Clearance (SSC) SPI is to reduce the likelihood of subcontractors or Ramboll employees encountering subsurface or overhead structures and utilities during intrusive activities being performed on Ramboll projects. The SSC requirements outlined in this SPI are met by:

- Implementing the procedures presented in this SPI
- Developing and implementing a site-specific Health and Safety Plan (HASP) / Risk Assessment (RA)
- Completing the Intrusive Work Pre-Project and Field Checklist
- Training employees
- Complying with applicable regulatory requirements; and
- Following guidance provided by a utility company and/or One Call organization, as applicable.

It is recognized that country-specific procedures may slightly vary (e.g., commercial line location services may not be available). In these instances, the minimum SSC requirements to be followed are presented in Section 7.0 of this SPI, “Manual Verification”.

Intrusive Activities (IA) include but are not necessarily limited to:

- Mechanical excavation (back hoes, drilling augers, probes, etc.);
- Manual ground penetration (other than surficial sampling and hand clearing when preapproved in Critical Zones);
- Intrusion in manmade surfaces (such as Sheetrock, asphalt, cement, flooring); and
- Mechanical scraping activity (e.g., road grading).

3. RISK ASSESSMENT

Conducting an effective risk assessment prior to commencing any job is an integral part of occupational health and safety management which identifies the potential hazards, assesses the risk and includes implementing control mechanisms. In general, the steps to be completed as part of a risk assessment are as follows:

11. Conduct a thorough review of the tasks that need to be performed to complete each job;

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12. Identify the hazards that may result in undesired events potentially causing injury, damage or environmental impacts;
13. Assess the level of risk based on these hazards that may arise when conducting the identified tasks; and
14. With a complete understanding of the proposed tasks, hazards and risks, implement the appropriate control mechanisms to mitigate the identified hazards.

Although a thorough risk assessment will need to be conducted for the entire proposed scope of work, at a minimum and in general, project personnel will need to include underground and/or overhead hazards as part of the overall risk assessment, as applicable. Some hazards to consider are as follows:

- **Chemical Hazards**: These may include the chemicals of concern on the site which personnel may come into contact with during work activities (e.g., drilling on a landfill, excavation of contaminated soils) and/or chemicals which are brought onto the site for use, if applicable;
- **Site Hazards**: The Site location and surrounding areas may have irritating plants/insects/animals, uneven walking/working surfaces, bodies of water, railroads, etc.;
- **Jobs/Tasks**: Specific jobs/tasks related to working around utilities (e.g., uncovering, striking and/or damaging an underground / overhead utility, heavy machinery/drill rigs, etc.); and
- **Safety Hazards**: Security issues, lone working, seasonal hunting, inclement weather, etc., as applicable.

The greatest risk when working around underground and/or overhead utilities is striking and/or damaging the utility. The risk varies with the type of line service for example, electricity versus water or telecommunication cables, etc.

Using the general hazards that are outlined above, the level of risk and the potential control mechanisms can now be assessed and implemented, respectively, which would complete an effective risk assessment. More importantly, the contents of this SPI should be used and considered as part of the risk assessment in order to understand and identify the specific task/job/project hazards, risks and control mechanisms associated with the type of work activities that is desired to be completed. In addition, other SPIs and/or country specific regulatory requirements (if more stringent than the applicable SPI) should also be considered as part of the overall risk assessment, as applicable.

4. ROLES AND RESPONSIBILITIES

- **Ramboll HSS Director and Designated Representatives:**
  - Approving exceptions to this SPI and intrusive work, as needed, in High Risk areas in advance, as required by this or HASP policy. Updating this policy as appropriate.

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- **Ramboll Project Director (PD) and Ramboll Project Manager (PM):**
  - Define contractual and legal responsibilities associated with intrusive activities before site work begins.
  - Ensure and verify that intrusive project work activities are consistent with the E&H SSC Programme, SPI, and any associated practices; provide guidance for other project team members.
  - Review and consider exceptions to the SSC Programme in advance; approve only after consultation with Designated Area Experts and the HSS Department, as needed.
  - Assigning responsibilities to trained and experienced Ramboll personnel (i.e., Designated Persons) in a manner consistent with goals and objectives of this SPI.
  - Approve the site-specific HASP for each project.
  - Retain project-related documentation in project file.
  - Support Stop Work reports from employees in the field.
  - Complete online and attend in-person training sessions as required.
- **High Risk Classified Ramboll Employees:**
  - Work closely with the Clearance Site Supervisor to support implementation of intrusive project work activities in compliance with the E&H Subsurface and Overhead Clearance (SSC) Programme, Standard Practice Instruction (SPI) Subsurface and Overhead Clearance, and any associated practices.
  - Support preparation of the site-specific HASP.
  - Approve the site-specific HASP for each project.
  - Support completion of the SSC Checklist
  - Stop work activities that pose a serious and imminent danger to persons, property, or the environment.
  - Complete online and attend in-person training sessions on the SSC Programme as required.

This employee is not trained to authorize intrusive activities but plays a supporting role in SSC projects.

- **Clearance Site Supervisor**
  - Plan and implement intrusive project work activities in compliance with the E&H Subsurface and Overhead Clearance (SSC) Programme, Standard Practice Instruction (SPI) Subsurface and Overhead Clearance, and any associated practices.
  - Consult in advance with Project Directors and Managers, Designated Area Experts, and the HSS Department, as needed, concerning any exceptions to the SSC Clearance Programme.
  - Direct preparation and approve the site-specific HASP for each project.
  - Complete and authorize [sign] the SSC Field Checklist.

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- Direct and authorize intrusive activities.
- Stop work activities that pose a serious and imminent danger to persons, property, or the environment.
- Complete online and attend in-person training sessions on the SSC Programme as required.

In order to qualify for this role, it is strongly recommended that the employee have:

- 1+ years of utility clearance experience with Ramboll – exceptions are granted on a case-by-case basis
- All training and responsibilities of a High Risk Classified Employee

Regional Site Solutions Leaders, with input from PDs, must determine the appropriate level of training, experience, and professional development required to qualify for the Clearance Site Supervisor Role.

- **Designated Area Expert**
  - Review and consider exceptions to the E&H Subsurface and Overhead Clearance (SSC) Programme in advance or during implementation of intrusive work activities with the support of the Project Director, Project Manager, and Clearance Site Supervisor.
  - Consult with the HSS Department as needed.
  - Authorized to provide project-specific variances to SSC Programme.

In order to qualify for this role, the employee must have:

- Progressed to a managerial level position
- 5+ years utility clearance experience with Ramboll
- All training and responsibilities of a Clearance Site Supervisor and High Risk Classified Employee

The HSS Department recommends at least one Designated Area Expert per country or region depending on the frequency of invasive work. For more information consult with your local Site Solutions leaders and the HSS Department.

5. MINIMUM REQUIREMENTS FOR SUBCONTRACTOR ENGAGEMENT

Subcontractors who provide locating services to Ramboll are required to meet the requirements in this SPI through use of their own standards, practices and procedures that meet or exceed those described in this SPI.

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Each project that utilizes a locating subcontractor must have a fully executed subcontract agreement in place prior to initiating any field activities. The agreement must:

- Utilize the template subcontract agreement form, or equivalent;
- Be signed by the applicable Ramboll representative;
- Define the project scope, budget, and general terms and conditions (T&C), at a minimum;
- Be correctly and completely executed by both parties;
- Be retained either in hard copy or electronically; and
- Accompanied by a proof of insurance. For projects completed in North America, the certificate of insurance must be provided, and at a minimum:
  - Comply with our subcontract agreement
  - Name Ramboll as additionally insured, and the client, as applicable;
  - Be valid and in effect for the entire project; and
  - Include the proper types and limits for the work being conducted (e.g., locator vs. driller).

Utility locating services without a fully executed subcontract agreement (or the equivalent) and proof of insurance are prohibited from working on Ramboll projects. Any deviation from this requirement must be pre-approved in writing by the PD and/or the Director of HSS and described in the HASP/RA.

Locating contractors should be able to or provide evidence of appropriate training and experience in:

- Operating the required equipment for locating underground utilities and interpreting and processing raw data to define the type, location and size of subsurface utility lines, where applicable;
- Maintaining and calibrating locating equipment;
- Serving as a liaison with local asset owners to gain their knowledge/experience of the area; and
- Where applicable, coordinating a public utility mark-out by contacting the designated “One-Call” agency for the area.

6. PRE-JOB PLANNING

An effective Subsurface Clearance Programme starts with clear client communication during contract negotiation, continues during project planning with a knowledgeable site representative and subcontractors, and is maintained during project implementation. The following tasks should be completed and documented prior to initiating intrusive activities (each of which is fully described in the sections referenced below):

- Historical site information review (Section 6.2)

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- Development of site-specific HASP/RA (Section 6.3)
- Preparation of a Plot Plan (Section 6.4)
- Pre-marking of intrusive locations (Section 6.5)
- Line location services (Section 6.6)
- Site walkover-visual inspection (Section 6.7)
- Utility mark out (Section 6.8)
- Clearance of Critical Zones (Section 6.9)
- Overhead lines (Section 6.10)

6.1 General Requirements

The PM or Designated Person must ensure that where applicable:

- The appropriate Line Location Organization (e.g., One Call, Dial Before You Dig, etc.) and private utility locators are notified a minimum of 72 business hours in advance of planned intrusive activities, or as applicable by the local, state, region or country requirements/regulations;
- Utilities are appropriately marked, and
- The proposed intrusive locations have been cleared to the Critical Zone.

Where Line Location Organizations and private utility locators are not available in a project area, the PD is to be notified and guidelines presented in Section 7.0 must be applied.

6.2 Historical Site Information Review

The PM or designated representative will ensure that available historical site records are reviewed and interviews of knowledgeable site personnel are conducted and cross referenced to determine the potential existence and location of underground facilities/pipelines and utilities in the vicinity of the work areas. When sources are reviewed and/or interviewed, this information will be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes).

The following are examples of information associated with identifying subsurface structures:

6.2.1 Maps and Plans

Plot plans, facility maps or lease drawings, as available, can be one source that can be reviewed and cross referenced with other sources of information to verify accuracy and develop a Plot Plan showing existing utilities and intrusive activities planned at the site as accurately as possible. The Plot Plan can be created onsite by hand in the field log, on an existing site plan, or in electronic format as long as the measurements and/or scale are accurate. Sources of information relevant to underground utility location may include:

- Maps and figures showing under and aboveground equipment, piping, utilities and/or any surface or subsurface hazards;

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- Historic site information (maps, photos, files);
- Site as-builts drawings;
- Easement maps and historical Plot Plans;
- Previous site investigations;
- Fire insurance plans;
- Tank dip charts; and
- Elevations and coordinate maps.

It is important to note that as-builts and historic maps may not accurately reflect existing conditions including proposed utilities that were never built or more recent modifications. Therefore, do not negate the requirement for a public and private utility locate, where available.

6.2.2 Interviews

When available or is reasonable to do so, the names of personnel that are consulted for information about utilities and subsurface structures in the purposed work area will need to be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes). Potential sources can include but not be limited to the following:

- Client / facility / operator personnel that may be familiar with area operations and/or may have knowledge of facilities/pipelines and/or abandoned and/or recently installed lines not otherwise documented.
- Landowner and/or tenants may also have knowledge of buried utilities and other site information.

6.3 HASP / RA

A site-specific HASP and/or RA must be developed prior to initiating field activities. Concerning SSC, the HASP/RA must:

- Complete the pre-project planning checklist (refer to Attachment A, Table 1) which outlines the SSC tasks to be completed prior to intrusive activities. Proposed dates and activities should be as accurate as possible for planned field activities. When information is not available at the time the HASP is drafted and approved, the Designated Person must ensure the pre-project planning checklist is updated and completed prior to intrusive activities. In addition to planning SSC steps for the project, this checklist should also be used to provide justification for each exemption to the required clearance processes;
- When on Site, and prior to intrusive activities, complete the SSC Field Checklist (refer to Attachment B, Table 2) for each location where intrusive activities are anticipated to occur or for each group of unobstructed intrusive locations. Conservative, professional judgment is to be used in determining whether subsequent intrusion points are unobstructed and if one SSC Field Checklist can be used to clear all locations. As a reminder, the SSC Field Checklist is to be completed prior to intrusive activities being

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performed and be used as a tool for double checking that all actions that need to be completed;

- Include a Plot Plan indicating the location of known underground and overhead facilities and utilities within the search zone available for reference at the work site;
- In the event intrusive work is required within a high risk area, include approval from PD and the Director of HSS.
- Include a list of emergency response resources with telephone numbers; and
- Include a list of client, regulatory, Ramboll, utility, and subcontractor emergency contact information and procedures.

If proposed field activities differ from the scope of work, Plot Plan and/or the Pre-Project Planning Checklist, the Designated Person will ensure that the project-specific HASP and Pre-Project Planning Checklist are updated to reflect these changes and communicate those changes to project personnel. Deviations from specified requirements must be documented and approved prior to the commencement of intrusive activities.

6.4 Plot Plan

Intrusive activities are not to proceed without a Plot Plan clearly indicating the facilities/pipelines or utilities, locations and their alignments in the project area. A Plot Plan is a map of the site that reflects the known underground facilities, pipelines and/or utilities in the vicinity of the work areas, proposed ground disturbance and/or intrusive areas, and visual indicators of underground utilities present at the site. Map may be hand-drawn, on an existing site or pipeline plan, or computer generated as long as the distances and/or scale are reflected.

If the information needed to create a Plot Plan is not available and/or known in the pre-planning stage, at a minimum, the logbook or field notes will include a map to reflect the Site, the proposed intrusive locations, and the Critical Zone surrounding them. While in the field, existing information can then be added to reflect available information (e.g., above ground visual indicators like a transformer or a gas meter), and site conditions as accurately as possible. If the Plot Plan is a separate, stand-alone document (i.e., not part of the field logbook), this information should also be clearly identified and referenced in the field logbook / notes.

6.5 Pre-Marking of Intrusive Locations

If practical, intrusive points and Critical Zones should be pre-marked with easily visible, identifiable markings such as brightly colored stakes, white paint or white flags (or black in cases where snow is on the ground) prior to the public and/or private utility mark-outs. Pre-marking provides the utility line locators with visual boundaries as guidance in clearing locations and placing marks.

During subsurface pre-project planning consider additional locations for clearance in the event that refusal is met at specific boring locations. A twenty-five percent (25%) buffer is recommended (i.e., one alternate boring location for every four (4) borings planned). Alternate borings also be located and cleared using the requirements outlined in this SPI.

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6.6 Line Location Services

In areas where public and private resources are available, Ramboll or a designated subcontractor will contact both public and private utility locate services for projects that involve intrusive activities.

In order to give utility line operators sufficient time to respond to a request to locate, a minimum of 3 business days should be provided prior to the planned start of work, or as required by local, state, region or country regulations.

In rare instances, confidentiality agreements may restrict notification of public utilities. In these cases, and when allowed by local regulations, this exception and justification must be noted in the HASP/RA and approved by the PM, PD and Director of HSS. In the event that a subcontractor performs the location, Ramboll will confirm with the subcontractor the utility locate information (including, but not limited to, the One Call (Attachment C) and /or private locate service contacted, confirmed public utilities on the site, positive responses from utility companies).

6.6.1 Public Utility Locate

Public utility locators may only mark lines on public property, easements or rights-of-way. This means private lines running from the main line may not be marked. To ensure that these lines are also located and marked, a Private Locating Company must be retained (see Section 6.6.2 below) entitled “Private Utility Locate”.

Nonetheless, it is important to provide an accurate location to the One Call service. Address, City, Township, County and other location designations can change and should be confirmed prior to submitting the clearance location to the One Call service. Universal search tools, such as Google, mapping tools, and the most up-to-date area maps, can be used to aid in verifying information where uncertainty exists.

When a One Call service order is made, otherwise known as a “ticket”, the One Call organization contacts each utility company that is a “member” of their service. Then, each member utility then sends out a One Call Utility Locator to mark their services in the area specified. The person who makes the call must confirm which utility companies are and are NOT included in their service and record this information in the Pre-Project Planning Checklist (Attachment A, Table 1).

It is important to provide as accurate a location for locating as possible to the One Call service. In some instances, a location may be annexed or moved from a township/county/location it had previously listed as an address, which can create confusion regarding the locate ticket request sent to the facility company. City, Township, County and other location designations should be confirmed prior to submitting the clearance location to the One Call service to ensure public locators clear the appropriate location(s). Universal search tools, such as Google, mapping tools, and the most up-to-date area maps, can be used to aid in verifying information where uncertainty exists.

It should be noted that in some areas, not all of the utility companies have agreements with the One Call service. This means that not all utility companies are part of the One Call

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process. For example, a city water or sewer department may not participate whereby their utilities would not be included nor marked by the One Call service. Hence, the Designated Person who places the One Call public locate request should follow-up with the One Call service to identify which utility companies are being dispatched to the location and record this information in the Pre-Project Planning Checklist (Attachment A, Table 1).

Crosscheck the list of member utilities in the proposed area with the following list of common utilities to ensure potential facilities have been identified on the site. This comparison can be documented on the SSC Field Checklist (Attachment B, Table 2) and/or field logbook:

- Telephone
- Cable television/communications
- Natural gas
- Electricity
- Water
- Sewer/storm water
- Optical fiber

Before intrusive activities begin, utilities must be marked or an "all clear" received, unless an exemption has been pre-approved. An "all clear" can consist of a mark at the site (such as "no electric" painted on the ground) or direct contact from the utility via fax, email or a phone call indicating the lack of facilities in the project area. If contact is not made by the agencies identified by the public utility locate process, it should **NOT** be assumed that such utilities are not present. Instead, the One Call service should be re-contacted to determine the status.

One Call services often provide a "positive" call back. This may mean that:

- Each member company notified the ticket originator that they do not have any facilities in the proposed dig area, or that they have marked the approximate locations (usually within a 48 hour period).
- The One Call service may have only posted a comment (e.g., they need an extension).

Therefore the nature of the positive call back must be confirmed. Communications regarding utilities for a specific project should be kept with the HASP/RA in the project file and/or written in the field logbook.

If contact is not made by the agencies identified by the public utility locate process, it should **NOT** be assumed that such utilities are not present. Instead, the public utility locate agency should be re-contacted to determine the status. If you arrive at the site and the public utilities have not been marked and /or "all clear" communications have not been received, **INTRUSIVE WORK IS TO BE HALTED** and a follow-up call made to the One Call service. Allow adequate time for the utility companies to respond to the re-mark request. Consider checking the work area for facilities/pipelines or utility markers or meters in order to verify the correct company has been contacted to clear utilities or supply additional information.

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Most public "One Call" utility mark-outs have a limited time period for which they remain valid. It is critical that this time period be taken into account to prevent the expiration of clearance prior to the completion of intrusive field activities. Confirm the ticket life is valid for the extent of the project. The applicable ticket life varies from locale to locale. An extension can be requested when there are no changes to the jobsite address or extent of work.

Generally, most standard public utility locators will only mark the main line for the utility company to which they are contracted and only mark up to the property line. Water and sewer companies locate main water lines in easements and rights-of-way and lines to a water meter, but may not locate the water facilities from a meter to a home or sewer lateral. Electric companies **usually** locate their lines to homes and businesses, but not those running to swimming pools pumps, irrigation systems or other buildings on the property. **This means private lines running from the main line may not be marked.** To locate and mark these lines, a Private Locating Company (see section 6.6.2 below) must be retained.

6.6.2 Private Utility Locate

When intrusive work occurs on or near private property, a private locator must be retained to locate utilities, as available. Many private locators will only locate from the marked utilities located by the public utility locate service by placing a trace signal on those lines and identifying where the lines are buried. While this is an accurate method for locating those specific lines, it is possible to miss utilities that are not identified by the public utility locate service.

A more comprehensive underground inspection will be conducted by the private locator, with special attention paid to any visual indicators or utilities, high risk areas and **the specific intrusive location(s), and Critical Zone(s)** using a search and sweep method, as project conditions warrant.

Some of the most common private facilities include:

- Fiber optic telecommunication cables
- Aboveground and underground tanks and delivery systems
- Industrial steam and condensate pipes
- Satellite television cables
- Stadium and security lights
- Lighted commercial signs
- Process water and fire protection systems
- Low voltage electrical wiring
- Electric fence / animal containment systems

Upon completion of their work, the private locator should contact the Designated Person to present their results. In addition to providing an overall summary of their work, the private locator should also identify any unique circumstance(s) that limited their ability in locating

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the potential presence of underground utilities (e.g., the existence of overhead electrical lines); if they encountered any abnormalities (e.g., concrete surfaces with reinforced rebar); and/or any other condition which may have diminished the validity of their results and efforts (e.g., concrete reinforced with rebar).

Further, designated Ramboll personnel technically trained and competent in using Cable Avoidance Tools (CATs) are required to clear Intrusive locations and/or areas prior to intrusive activities. This is both in areas where private and public locators are and are not available.

6.7 Site Walk-Visual Inspection

The Designated Person must complete the SSC Field Checklist (Attachment B, Table 2) during a site walk-visual inspection to identify above ground indicators which may identify the potential existence of subsurface issues and to confirm that common and/or expected utilities have been accounted for, located and verified prior to commencing intrusive activities. The site walkover and visual inspection is most effective when done during the private locate, because the extent of locating efforts can be verified and questions regarding visual indicators answered. Where possible, a site representative with knowledge of subsurface utilities/structures should also participate in the site walk/visual inspection.

Visible indicators are evidence of underground utilities within the proposed work area and search zone, examples of which are contained in Attachment D, “Anatomy of Utilities”. These may include:

- Facilities/pipelines
- Power lines
- Natural gas pipelines
- Gas meters
- Aboveground and underground tanks
- Electric service risers
- Utility cables
- Nearby lines and structures
- Patches in concrete or asphalt
- New clearings
- Spoil piles
- Road construction
- Previously disturbed soils
- Service pits
- Buildings with no visible evidence of service
- New vegetation, color changes or growth

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- Edge of any tank basin, pump island, pump gallery, manifold, electrical transformer, compressor, production well, explosive magazines, loading rack, or other process equipment with associated underground lines.

If any visual indicators are discovered during the site walk that are not reflected on the Plot Plan, the field book and the Plot Plan must be accurately marked to reflect these observations. Intrusive work will not commence until identified issues with the indicators have been resolved.

Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PD.

6.8 Utility Mark-out

Known pipelines and utilities that pass within the search zone will be located, identified and marked to indicate location and alignment and be documented.

If possible, the Designated Person should meet with the private locator to provide him or her with:

- Intrusive plans pre-marked with intrusive locations and Critical Zones as well as an appropriate number of alternate locations
- A Plot Plan and/or the results of the visual inspection
- Plans depicting proposed exploration / excavation locations.

If an onsite meeting with the private locator is not possible, conduct a phone call with the private locator to ensure they understand the scope of the proposed subsurface work and the extent of activities.

A qualified and competent line locator (as outlined in Section 4) should:

- Conduct private line-locating practices utilizing appropriate equipment (Attachment E provides a brief description of the types and attributes of commonly used locator tools) and Plot Plans for all areas within the search zone.
- Directly connect (clamp on) to possible nearby underground services to increase the success rate/reliability in locating.
- Energize electrical sources within the vicinity (e.g., light poles, signs, pumps, etc.) at the time of locating. This increases the chance of identifying potential underground electrical services.

If anticipated services have not been identified or located, drilling or intrusive work will not occur until the service is visually identified or confirmed to be absent. Examples include: when a visual indicator of a line is present (such as a sewer grate) and no line is traced from it, or if a utility line is indicated on a historical site drawing, but no investigation has occurred in the field to confirm or deny its presence. Potential intrusive locations with suspected subsurface utilities/structures present must be avoided and a new location at least five feet (1.5 meters) away must be cleared.

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Using the information obtained during the visual inspection, public One Call mark-out and the private utility mark-out, the proposed exploration/excavation locations will be confirmed in the field. The markings of locations should be made in accordance with the generally accepted color code for facilities identification for the region. Attachment F provides examples of commonly used utility mark out colors and identifiers, which may differ by area, region or country. Check local regulations prior to intrusive activities to ensure that markings are clearly understood by the field staff.

Further, where Ramboll personnel are trained and competent in their use, Cable Avoidance Tools (CATs) will be used to clear intrusive locations and/or areas to the Critical Zone prior to intrusive activities.

6.8.1 Line Location Methods

A variety of remote sensing technologies can be used for detecting underground facilities depending on structural composition of the buried materials, soil composition, and surface access. There is no one procedure or tool that can provide accurate location information for all types of facilities in all types of situations. Attachment E entitled “Underground Locating Equipment” provides a brief description of the types and attributes of commonly used locator tools.

In addition to equipment choice, there are situational variables that affect detection accuracy. For example, the more conductive the soil, the more shallow the conductor can appear. Sandy, loose soil with a high mineral content can give sensitive readings; pipe locations under these conditions may be deeper than the locator equipment readings indicate. Moisture content or water table levels can also affect depth readings. Locating indoors provides additional difficulties, including but not limited to interference from reinforced concrete, canopies, and metallic structures.

For equipment that determines location by sensing an electronic signal introduced into the underground system, the strength of the equipment depends on where the signal was introduced into the system, proximity of structural uprights connected to the underground system, and nearby surface obstructions that dissipate the signal. Selection of radio signal frequency can also affect signal clarity. **Equipment readings cannot be taken as absolute values.** They depend on situational effects associated with locator equipment calibration, field conditions, and the operator’s familiarity with the particular operating characteristics.

Plastic and concrete pipe and fiber optic cable are difficult to detect with common locator tools because they do not contain metal. A metal tracer wire or detectable warning tape may be buried with or attached to the pipe/facility when they are first installed to aid in locating these structures at a future date. Varieties of tracer wire and detectable tape are designed to be sturdy enough to be plowed into the trench during backfill operations.

6.9 Clearance of Disturbance Locations within Critical Zones

After anticipated utilities have been located and marked, use the available information along with regulatory requirements and project objectives to select final intrusive locations **that**

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have been cleared to the edge of the Critical Zone. Ensure that detected services and those featured on location plans are outside of the Critical Zone.

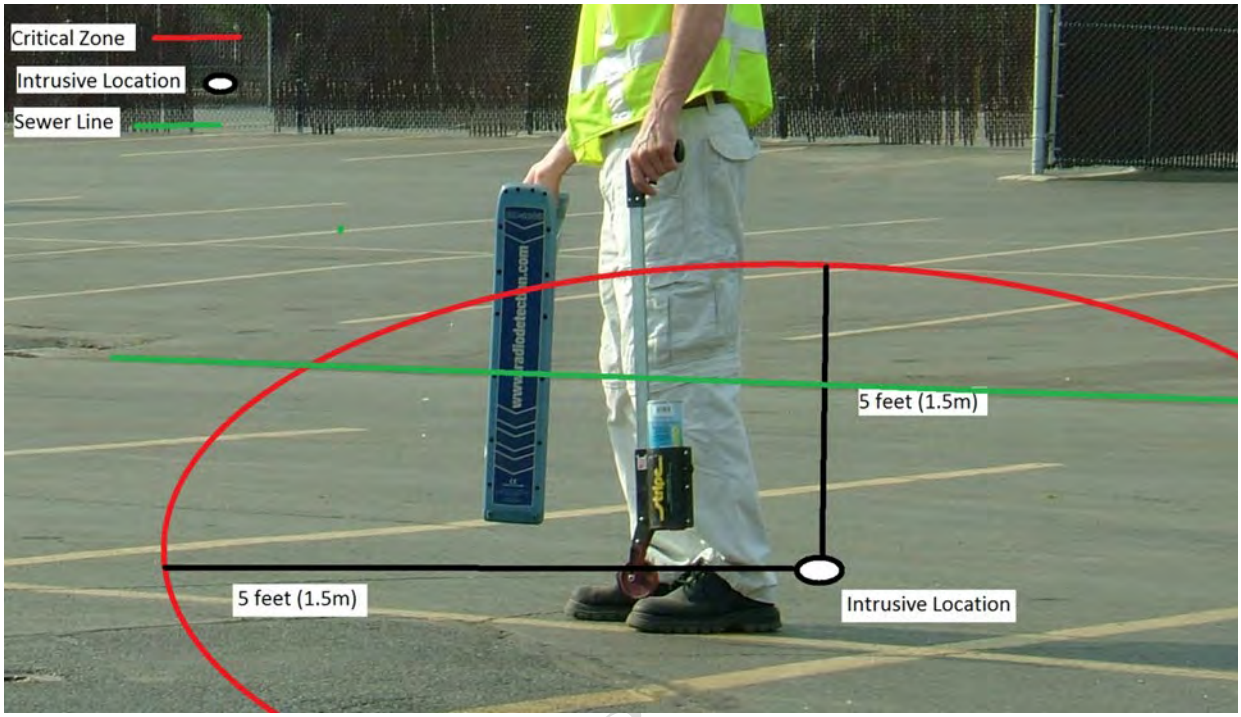

Figure 2:

A private locator clears the Critical Zone for a boring location. In this figure, the visual indicator of the sewer line is outside the Critical Zone, but the line has been laterally traced to the edge of the Critical Zone, therefore a new boring location should be chosen.

The Critical Zone takes into account minimum tolerance distances from facility lines (which vary by location) and uncertainties introduced by onsite conditions, human factors, and equipment. When known utilities intersect Critical Zones, the PM must be notified and ideally, the intrusive location would be moved to a pre-cleared alternate location. Intrusive activities will not take place within a Critical Zone where utilities or visual indicators intersect without the prior approval of the HSS Director.

In the event that work must be conducted in a Critical Zone containing a marked utility or visual indicator, approval must be obtained from the PD and Director of HSS prior to conducting intrusive activities. The approval and approved methodology for intrusive work closer than 5 feet (1.5 meters) from utilities will be made on a case-by-case basis once adequate information has been provided and reviewed by the Director of HSS, and PD. The decision will be made based on:

- Location criteria (the reason a boring/sample is needed in that location);
- Distance from the utility;
- Drilling method;

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- Confidence in location methods;
- Geophysical conditions at the site;
- Pipe construction and contents;
- Regulated tolerance distance at the location; and
- Other influencing factors.

At a minimum, any mechanical intrusive activities that occur within 5 feet (1.5 meters) of a utility or indicator AND have been authorized by the PD, PM, Designated Area Expert, and Director of HSS, as needed, will be hand cleared or vacuum excavated to a depth of 6 feet (1.8 meters). **Hand digging or auguring, manual excavation or soft-dig techniques may not be used in lieu of the SSC requirements presented in this SPI.** Any deviation from these requirements stated must be approved in advance by the PD, Designated Area Expert, and Director of HSS, as needed.

6.10 Overhead Lines

Overhead power lines that may pose a hazard during movement of equipment must be clearly documented and minimum clearance distances will be maintained. Regulated minimum distances vary by voltage, area, region, and country. When voltage(s) of nearby power lines have been determined and confirmed by the utility company, Ramboll personnel will maintain the minimum distance required by applicable regulations or requirements.

When the specific voltage and minimum clearance distances are **unknown**, the following clearance distances will be maintained:

- Intrusive activities performed by raised mechanical equipment must be located a minimum clearance distance of:
  - 28 feet (8.5m) horizontally from any overhead electric cable supported on wooden poles; or
  - 50 feet (15.25m) horizontally from any overhead electric cable supported on metal poles/towers.

If clearance distances cannot be achieved, the relevant electricity provider must be contacted for guidance; the PD and Director HSS will be notified as well.

To apply the clearance distances described above:

1. Estimate the ground position parallel to the power line overhead based on visual observations. Do NOT come in physical contact with the line or use vertical tools to estimate positioning.
2. From that ground position, measure the lateral distance from the line as required above
3. Ensure intrusive locations are further than the required distance from overhead lines. Repeat steps 1 and 2 at different locations, as necessary to address larger intrusive areas.

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4. Take strong winds that may cause the lines to move or droop, into consideration and give the drill mast a 3-foot (0.9m) buffer zone.

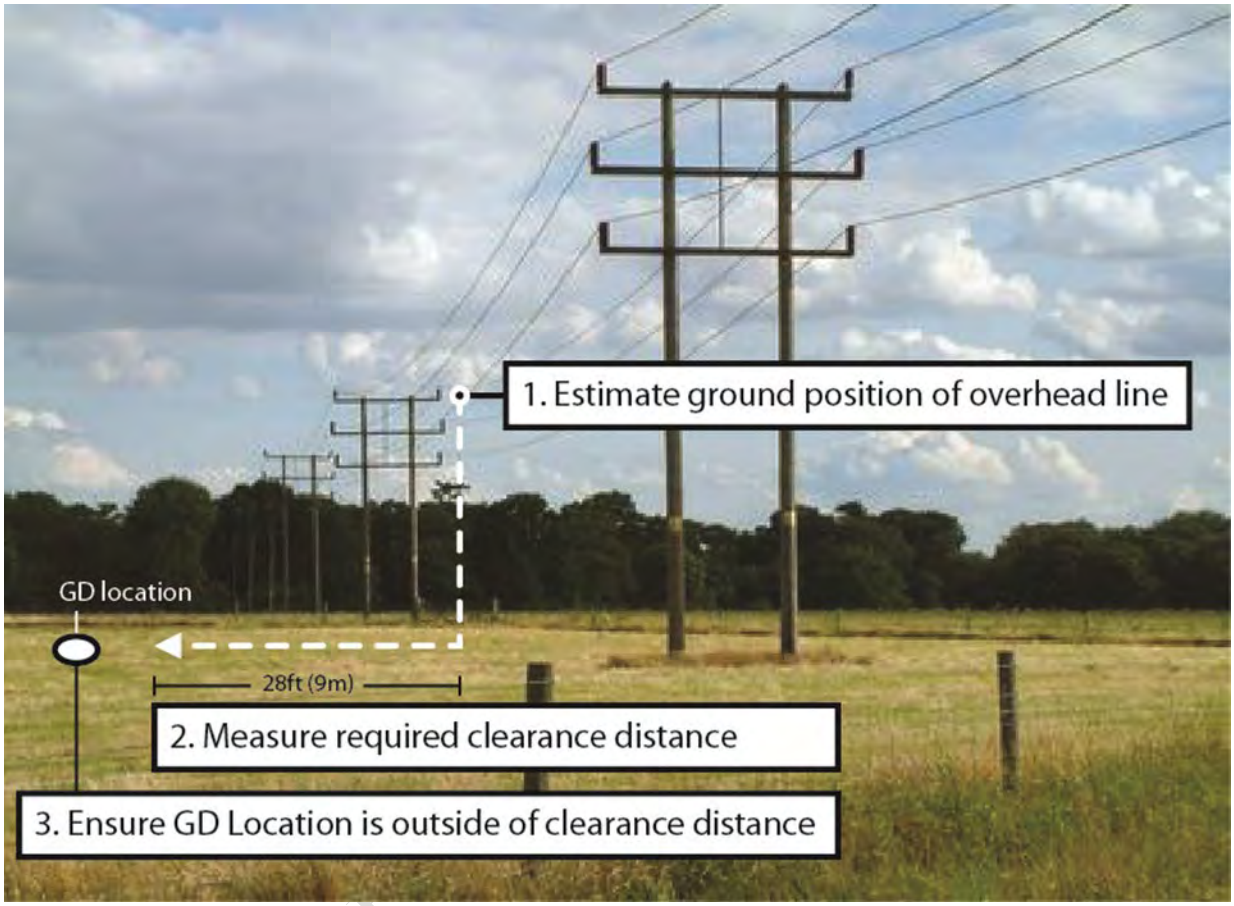

Figure 3:

To measure the ground distance from an overhead utility line, estimate the ground position of the line, measure the lateral distance from that point, and ensure the boring location is outside the clearance area.

A spotter must be used when mechanical equipment is being raised or lowered, to ensure safe distances are maintained. Keep in mind that the angle changes as the mast moves and travels into its vertical position.

7. MANUAL VERIFICATION

In areas where public and private utility locators are **not** available or cannot access the site, in general, the work practices conducted prior to intrusive activities are exactly the same as when private locates are available, with the exception that Ramboll employees have the responsibility of clearing the Critical Zone surrounding each intrusive location. More

specifically, the requirements to be followed for areas where public and private utility locators are **not** available or cannot access the site, verify that:

- A local One Call organization and private utility locators are not available for the area;
- Due diligence regarding historical site information has been performed and a site-specific Plot Plan has been developed;
- A visual inspection has been performed;
- The proposed intrusive locations are cleared to a minimum of 5 feet (1.5 meter) extending in the horizontal direction where intrusive work is planned, and;
- Hand digging, hand auguring, or soft-dig methods (i.e., vacuum excavation) will be employed to a depth of 6 feet (1.8 meter) below ground surface (bgs).

7.1 Historical Site Information Review

The PM or designated representative will ensure that available historical site records are reviewed and interviews of knowledgeable site personnel are conducted and cross referenced to determine the potential existence and location of underground facilities/pipelines and utilities in the vicinity of the work areas. When sources are reviewed and/or interviewed, this information will be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes).

The following are examples of information associated with identifying subsurface structures:

7.1.1 Maps and Plans

Plot plans, facility maps or lease drawings, as available, can be one source that can be reviewed and cross referenced with other sources of information to verify accuracy and develop a Plot Plan showing existing utilities and intrusive activities planned at the site as accurately as possible. The Plot Plan can be created onsite by hand in the field log, on an existing site plan, or in electronic format as long as the measurements and/or scale are accurate. Sources of information relevant to underground utility location may include:

- Maps and figures showing under and aboveground equipment, piping, utilities and/or any surface or subsurface hazards;
- Historic site information (maps, photos, files);
- Site as-builts drawings;
- Easement maps and historical Plot Plans;
- Previous site investigations;
- Fire insurance plans;
- Tank dip charts; and
- Elevations and coordinate maps.

It is important to note that as-builts and historic maps may not accurately reflect existing conditions including proposed utilities that were never built or more recent modifications.

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Therefore, do not negate the requirement for a public and private utility locate, where available.

7.1.2 Interviews

When available or is reasonable to do so, the names of personnel that are consulted for information about utilities and subsurface structures in the purposed work area will need to be documented (e.g., in the HASP / RA, on the SSC Project Checklist, and/or contained in the logbook / field notes). Potential sources can include but not be limited to the following:

- Client / facility / operator personnel that may be familiar with area operations and/or may have knowledge of facilities/pipelines and/or abandoned and/or recently installed lines not otherwise documented.
- Landowner and/or tenants may also have knowledge of buried utilities and other site information.

7.2 HASP / RA

A site-specific HASP and/or RA must be developed prior to initiating field activities. Concerning SSC, the HASP/RA must:

- Complete the pre-project planning checklist (refer to Attachment A, Table 1) which outlines the SSC tasks to be completed prior to intrusive activities. Proposed dates and activities should be as accurate as possible for planned field activities. When information is not available at the time the HASP is drafted and approved, the Designated Person must ensure the pre-project planning checklist is updated and completed prior to intrusive activities. In addition to planning SSC steps for the project, this checklist should also be used to provide justification for each exemption to the required clearance processes;
- When on Site, and prior to intrusive activities, complete the SSC Field Checklist (refer to Attachment B, Table 2) for each location where intrusive activities are anticipated to occur or for each group of unobstructed intrusive locations. Conservative, professional judgment is to be used in determining whether subsequent intrusion points are unobstructed and if one SSC Field Checklist can be used to clear all locations. As a reminder, the SSC Field Checklist is to be completed prior to intrusive activities being performed and be used as a tool for double checking that all actions that need to be completed;
- Include a Plot Plan indicating the location of known underground and overhead facilities and utilities within the search zone available for reference at the work site;
- In the event intrusive work is required within a high risk area, include approval from PD and the Director of HSS.
- Include a list of emergency response resources with telephone numbers; and
- Include a list of client, regulatory, Ramboll, utility, and subcontractor emergency contact information and procedures.

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If proposed field activities differ from the scope of work, Plot Plan and/or the Pre-Project Planning Checklist, the Designated Person will ensure that the project-specific HASP and Pre-Project Planning Checklist are updated to reflect these changes and communicate those changes to project personnel. Deviations from specified requirements must be documented and approved prior to the commencement of intrusive activities.

7.1 **7.3 Plot Plan**

Intrusive activities are not to proceed without a Plot Plan clearly indicating the facilities/pipelines or utilities, locations and their alignments in the project area. A Plot Plan is a map of the site that reflects the known underground facilities, pipelines and/or utilities in the vicinity of the work areas, proposed ground disturbance and/or intrusive areas, and visual indicators of underground utilities present at the site. Map may be hand-drawn, on an existing site or pipeline plan, or computer generated as long as the distances and/or scale are reflected.

If the information needed to create a Plot Plan is not available and/or known in the pre-planning stage, at a minimum, the logbook or field notes will include a map to reflect the Site, the proposed intrusive locations, and the Critical Zone surrounding them. While in the field, existing information can then be added to reflect available information (e.g., above ground visual indicators like a transformer or a gas meter), and site conditions as accurately as possible. If the Plot Plan is a separate, stand-alone document (i.e., not part of the field logbook), this information should also be clearly identified and referenced in the field logbook / notes.

7.4 Site Walkover-Visual Inspection

The Designated Person must complete the SSC Field Checklist (Attachment B, Table 2) during a site walk-visual inspection to identify above ground indicators which may identify the potential existence of subsurface issues and to confirm that common and/or expected utilities have been accounted for, located and verified prior to commencing intrusive activities. The site walkover and visual inspection is most effective when done during the private locate, because the extent of locating efforts can be verified and questions regarding visual indicators answered. Where possible, a site representative with knowledge of subsurface utilities/structures should also participate in the site walk/visual inspection.

Visible indicators are evidence of underground utilities within the proposed work area and search zone, examples of which are contained in Attachment D, “Anatomy of Utilities”. These may include:

- Facilities/pipelines
- Power lines
- Natural gas pipelines
- Gas meters
- Aboveground and underground tanks
- Electric service risers

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- Utility cables
- Nearby lines and structures
- Patches in concrete or asphalt
- New clearings
- Spoil piles
- Road construction
- Previously disturbed soils
- Service pits
- Buildings with no visible evidence of service
- New vegetation, color changes or growth
- Edge of any tank basin, pump island, pump gallery, manifold, electrical transformer, compressor, production well, explosive magazines, loading rack, or other process equipment with associated underground lines.

If any visual indicators are discovered during the site walk that are not reflected on the Plot Plan, the field book and the Plot Plan must be accurately marked to reflect these observations. Intrusive work will not commence until identified issues with the indicators have been resolved.

Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PD.

7.5 Utility Mark-out

Known pipelines and utilities that pass within the search zone will be located, identified and marked to indicate location and alignment and be documented using, but not limited to:

- Intrusive plans pre-marked with intrusive locations and Critical Zones as well as an appropriate number of alternate locations
- A Plot Plan and/or the results of the visual inspection
- Plans depicting proposed exploration / excavation locations.

If anticipated services are not identified or located, intrusive work is not to occur until the service is visually identified or confirmed to be absent. Where doubt exists over the location of a service, request a site visit from the appropriate utility provider or abandon locations in the immediate area and contact the PM and/or PD. Examples include: when a visual indicator of a line is present (such as a sewer grate) and no line is traced from it, or if a utility line is indicated on a historical site drawing, but no investigation has occurred in the field to confirm or deny its presence. Potential exploration locations with suspected subsurface utilities/structures present are to be avoided and a new location at least five feet (1.5 meters) away will be similarly cleared.

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Further, where Ramboll personnel have been trained and are competent in the use of Cable Avoidance Tools (CATs), in general, the information discussed above should be reviewed and the following first steps taken to locate utilities:

- Conduct line-locating practices utilizing appropriate equipment and Plot Plans for all areas within the search zone.
- Directly connect (clamp on) to possible nearby underground services to increase the success rate/reliability in locating.
- Energize electrical sources within the vicinity (e.g., light poles, signs, pumps, etc.) at the time of locating. This increases the chance of identifying potential underground electrical services.

7.6 Clearance of Disturbance Locations within Critical Zones

After anticipated utilities have been located and marked, use the available information along with regulatory requirements and project objectives to select final intrusive locations **that have been cleared to the edge of the Critical Zone**. Ensure that detected services and those featured on location plans are outside of the Critical Zone.

The Critical Zone takes into account minimum tolerance distances from facility lines (which vary by location) and uncertainties introduced by onsite conditions, human factors, and equipment. When known utilities intersect Critical Zones, the PM must be notified and ideally, the intrusive location would be moved to a pre-cleared alternate location. Intrusive activities will not take place within a Critical Zone where utilities or visual indicators intersect without the prior approval of the HSS Director.

In the event that work must be conducted in a Critical Zone containing a marked utility or visual indicator, approval must be obtained from the PD, Designated Area Expert, and Director of HSS, as needed, prior to intrusive activities. The approval and approved methodology for intrusive work closer than 5 feet (1.5 meters) from utilities will be made on a case-by-case basis once adequate information has been provided and reviewed by the Director of HSS, and PD. The decision will be made based on:

- Location criteria (the reason a boring/sample is needed in that location);
- Distance from the utility;
- Drilling method;
- Confidence in location methods;
- Geophysical conditions at the site;
- Pipe construction and contents;
- Regulated tolerance distance at the location; and
- Other influencing factors.

At a minimum, any mechanical intrusive activities that occur within 5 feet (1.5 meters) of a utility or indicator AND have been authorized by the PD, Designated Area Expert, and

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Director of HSS, as needed, will be hand cleared or vacuum excavated to a depth of 6 feet (1.8 meters). **Hand digging or auguring, manual excavation or soft-dig techniques may not be used in lieu of the SSC requirements presented in this SPI.** Any deviation from these requirements stated must be approved in advance by the PD and Director of HSS.

8. ON-SITE ACTIVITIES

8.1 General

The following requirements will be completed before beginning work:

- Confirm the written approvals and agreements discussed in Section 5 of this SPI, have been obtained;
- Confirm underground and overhead utilities have been located in the general search area, Critical Zone/proposed intrusive location(s);
- Electrical sources on-site must be de-energized during intrusive activities, where possible;
- Emergency shutoffs should be located and noted on plot plan;
- NEVER allow mechanical equipment to be moved when elements are in the extended position, such as a drill rig with the mast in the raised or partially raised, or a dump truck with a raised bed; and
- Notify landowners and/or tenant, where necessary and practicable.

8.2 SSC Field Checklist

In general, the Checklist serves as an intrusive activity permit. Intrusive activities will only begin once the Checklist has been reviewed, completed and accepted by the Clearance Site Supervisor on-site. Prior to commencing intrusive activities, the Designated Person on-site will review the information contained in Attachment A, Table 1 and complete the Subsurface Clearance (SSC) Field Checklist (Attachment B, Table 2).

The Subsurface Field Checklist must be completed for each location (e.g., each drilling location) where intrusive activities will occur or each group of unobstructed locations. The completed form must be retained with the HASP in the project file, and acknowledgement that the SSC Field Checklist has been completed will be documented in the field logbook. Alternatively, it is acceptable to note that each item on the Checklist has been reviewed in the field logbook, in lieu of completing the separate form.

8.3 Daily Safety Meeting

A daily safety meeting will be conducted and documented in the HASP / RA or the field log book including the topics discussed and a signed attendance list with the printed name of the attendee, their signature, and company affiliation.

The following topics, at a minimum, will be included in the meeting:

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- Review of the HASP/RA including the Hazard Analysis and Control Summary (i.e., potential hazards and safe work practices), Emergency Response Plan, applicable permitting requirements, etc.
- Review of the SSC Checklist.
- Proposed intrusive locations/areas will be adequately marked and the Critical Zone cleared. Locations that have been marked on the ground and have been cleared by the private locator are considered **FIXED**. Intrusive operations MAY NOT be conducted at any position within the Critical Zone, other than that point or area at the center specifically cleared to 5 feet (1.5 meters) unless approval has been granted by the PD and the Director of HSS.
- Agree that project field staff have the right and responsibility to 'Stop Work' as outlined in Section 7.5.
- Donning proper personal protective equipment (PPE) as outlined in the respective HASP / RA, as required.
- Accidents, injuries, provision of first aid, near misses and unsafe acts or conditions are to be reported in accordance with SPI 19. "Incident Reporting".

8.4 Stop Work Authority

Ramboll personnel have the responsibility and authority to stop work or decline to perform an assigned task without fear of reprisal should they believe such work presents an unacceptable or unmitigated hazard. The Stop Work Authority may include, but is not limited to, discussions with co-workers, supervisors, or safety representatives to resolve work related issues or concerns, address potential unsafe conditions, clarify work instructions, and/or propose additional controls.

Under NO circumstances are work activities to be performed if:

- The public and/or private locate is incomplete;
- There is an uncertainty with the results of the public and/or private locate;
- Additional information is provided after the public/private locates have been performed that contradicts/conflicts with existing information;
- Work is required within the Critical Zone surrounding proposed intrusive location that has not been agreed upon by the PD and Director of HSS; and/or
- Identified unsafe conditions or safety concerns have not been resolved.

In these instances, the PD, PM and/or Director of HSS **MUST** be contacted for further input and guidance **PRIOR** to proceeding with work activities.

9. INCIDENT MANAGEMENT

Uncovering, damaging, or dislocating of an underground utility and/or contact with overhead utility lines are considered a reportable incident to Ramboll and will follow the requirements set forth in SPI 19 Incident Reporting.

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Nonetheless, in the event of uncovering an underground or overhead utility intact and undamaged:

- Cease work activities in the area of the facility/pipeline or utility.
- Clear all personnel from the area.
- Immediately call the applicable emergency phone number(s). If there is an immediate danger to human health or the environment, call 911 or the regional/national equivalent.
- Notify the affected utility and One Call services, if applicable. The One Call service may be able to assist with contact numbers for notifying member companies in the event of any damage.
- DO NOT attempt to repair, clamp or constrict the damaged utility.
- Notify the PM, PD, HSSC and the Director of HSS. The PM or PD will contact the Client/Property Owner/Tenant and MP.
- ALWAYS ASSUME THAT ANY UNDERGROUND PIPE OR SUBSURFACE LINE IS LIVE!
- Take photographs from a distance that is safe to do so. Take statements from witnesses at the scene.
- Mark the underground structure(s) on the Plot Plan and move to an alternate cleared location, if available, once the Directors of HSS or their designated representatives have given approval for work to continue.

9.1 Damaging an Underground Electrical/Telecom Cable

- Stop work.
- Evacuate all personnel from the immediate area to a safe distance as site conditions warrant, giving consideration to employees which may not be able to safely evacuate (e.g., the excavator that hit the line may now be energized and the operator may not be able to safely exit the vehicle).
- Call the emergency number (e.g., fire, police, site-specific emergency service).
- Provide first aid and summon medical assistance, as needed.
- Contact the One Call/utility member for guidance, if applicable.
- Notify the PM, PD, HSSC and the Director of HSS. The PM or PD will contact the Client/Property Owner/Tenant and MP.
- Do not allow anyone to enter the area until the electricity/utility provider has made the cable safe.

9.2 Damaging a Pressurized Gas Pipeline

- Stop work.
- Leave tools in-place but shut off any running/energized equipment, and/or potential sources of ignition in the area
- Evacuate the immediate area to a safe distance as site conditions warrant.

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- Call the emergency number.
- Contact the pipeline owner and/or One Call, if applicable.
- Notify the PM, PD, HSSC and the Director of HSS. The PM or PD will contact the Client/Property Owner/Tenant and MP.
- Do not re-enter the immediate area.

9.3 Damaging a Pressurized Water Main

- Stop work, remove tools and confine jetting water if safe and necessary to do so.
- Evacuate immediate area.
- Call the emergency number.
- Contact the water utility and/or One Call, if applicable.
- Ensure that water is not creating additional potential hazards (e.g., electrical shorting, flooding, contaminant migration etc.) and where possible warn those likely to be affected.
- Notify the PM, PD, HSSC and the Director of HSS. The PM or PD will contact the Client/Property Owner/Tenant and MP. Do not re-enter the immediate area.

9.4 Mandatory Follow-up Procedures

If a site employee is injured on-site and immediate medical treatment beyond first aid is needed, the designated site supervisor is instructed to call 911 (or other designated emergency phone number) and then report the incident via Ramboll's Incident Reporting System (SPI 19).

If the post-incident investigations and root cause analysis result in amendments to the HASP, they will be approved and implemented by the Project HSSC or the Director of HSS. All site personnel will be informed of the revisions to the HASP and the resolution of any outstanding safety concerns prior to returning to their Site functions.

The necessary steps to ensure that operations can safely resume include:

- Receiving an "all-clear" from the impacted utility.
- Ensuring that all emergency equipment (fire extinguisher, communication system, first aid kits and first aid station) is in functional order;
- Clearing all incident-caused debris from the Site, if safe to do so;
- Inspecting area and equipment that may have been impacted by the incident; and
- Approval by the Directors of HSS or their designated representative.

10. RECORDKEEPING

The following records will be maintained in the onsite project files and transferred to the main project file when the project is complete:

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- A complete Pre-Project Planning Checklist (Attachment A, Table 1) summarizing SSC methods and providing justification for any exemptions to the required clearance process.
- Field Log Book including:
  - A detailed summary of the site visual inspection conducted prior to the initiation of intrusive field activities including the names/titles of site representatives interviewed, the areas reviewed for intrusive activities, and the potential presence of subsurface utilities/structures as reported by the site representatives.
  - Potential underground utilities or subsurface structures identified during the public and/or private utility mark-out.
  - Applicable information regarding the public "One Call" mark-out, ticket number, existing utilities, etc..
- Subsurface Clearance Field Checklist included in the site-specific Health and Safety Plan (Attachment B, Table 2) for each drilling location where intrusive activities might occur.
- Plot Plan, including any updates, reflecting the location(s) of known underground and overhead facilities and utilities with the search zone.

11. MINIMUM TRAINING REQUIREMENTS

- **Ramboll Project Director (PD) and Ramboll Project Manager (PM):**

Training enables an employee to serve as Project Director or Project Manager on projects involving intrusive or overhead work and will be required in order to sign-off on health and safety plans involving SSC.

  - Required annual online training on roles, responsibilities and communications
  - Required annual online scenario-based training
  - Recommended annual online training on equipment and methods
  - In-person professional development activities as available

The online training on responsibilities and communications is assigned annually to ALL Project Directors and Project Managers with the potential to manage or direct projects with intrusive work, regardless of HSS risk classification level.

- **High Risk Classified Ramboll Employees:**

Training enables an employee to serve as a project team member on a project involving intrusive or overhead work and will be required in order to sign-off on health and safety plans involving SSC.

  - Required annual online training on responsibilities and communications
  - Required annual online scenario-based training
  - Required annual online training on equipment and methods

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  - In-person professional development activities as available

- **Clearance Site Supervisor**

Training enables an employee to direct intrusive work and authorize [sign] in-field SSC Checklists.

  - Required annual online training on responsibilities and communications
  - Required annual online scenario-based training
  - Required annual online training on equipment and methods
  - In-person professional development activities as available
  - Online in-depth infrastructure and location technology training
  - In-person locator training to be provided by an outside vendor or internally by the Site Solutions Group

- **Designated Area Expert**
  - Required annual online training on responsibilities and communications
  - Required annual online scenario-based training
  - Required annual online training on equipment and methods
  - In-person professional development activities as available
  - Online in-depth infrastructure and location technology training
  - In-person locator training to be provided by an outside vendor or internally by the Site Solutions Group
  - Participation in, at a minimum, quarterly meeting with HSS Department to review utility incidents, lessons learned and safety insights, best practices, and support development of scenario-based online training

12. REFERENCES

American Public Works Association. April 1999. Uniform Color Code (http://www.apwa.net/).

American Society for Testing and Materials. September 1999. Standard Guide for Selecting Surface Geophysical Methods (D 6429-99).

NJUG Guidelines on the Positioning and Colour Coding of Underground Utilities' Apparatus. Volume 1. October 2013.

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13. REVISION SUMMARY

Version	Author	Description of Change	Date
6.0	KMH, CD	Update to existing language/organization; updated definition/acronyms; updated pictures; added Risk Assessment section; updated tables.	11/2013
8.0	KMH, AMK	Update to Basis, Executive Summary, Roles and Responsibilities, and Minimum Training Requirements. Revised Pre-Planning Worksheet and Subsurface Clearance Checklist.	4/2019

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ATTACHMENT A
PRE-PROJECT PLANNING CHECKLIST

Table 1: Pre-Project Planning Checklist

Pre-Project Planning Checklist for Intrusive Work
Document the steps that must be followed and justify any exceptions.
This checklist MUST be completed in its entirety.

SSC Requirements	Yes	No	NA	Comments
Prequalification of Contractor for capability of locating work (See Section 4)	☐	☐	☐	Name of subcontractor(s)
Historical Site Information Review	☐	☐	☐	Specify what information was reviewed (e.g., maps, figures, photos, as-built drawings)
Interviews Conducted	☐	☐	☐	List personnel interviews conducted
Development of site-specific Plot Plan	☐	☐	☐	Denote where a copy can be found (i.e., Attachment D to project HASP, Specific project file name, will be developed on-site, etc.
Intrusive location(s) will be marked prior to locate(s) and alternate locations chosen	☐	☐	☐	Describe reason for exception if not performed or not applicable
Service notifications provided to clear/locate **public** utilities	☐	☐	☐	List companies notified for public locate (for example): ☐ Electric: Ameren ☐ Telephone: AT&T ☐ Cable: Comcast ☐ Gas: Marathon ☐ Sewer: City of Chicago Who contacted One Call: Driller, Ramboll One Call #: 811, 800-892-0123 Locate ticket #: XCR1234
Private locate contracted for on-site utilities	☐	☐	☐	Name of subcontractor(s)
Designated Person or duly authorized representative will be present during private locating	☐	☐	☐	Name of Designated Person: Describe reason for exception if not performed or not applicable
Pre-Project Checklist for Intrusive Work completed by:				

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ATTACHMENT B
SSC FIELD CHECKLIST

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SUBSURFACE CLEARANCE (SSC) FIELD CHECK LIST

(Use this form to document & identify field elements of SSC. Retain the completed form with the project file)

Site Name/Project No.: _____ Designated Person: _____

Walkover Date: _____ PM: _____

Intrusive Locations Surveyed: _____

(Ramboll MANAGED SUBSURFACE CLEARANCE ACTIVITIES)	Yes	No	N/A	Comments
1. The potential for unexploded ordnance (UXO) has been assessed and a UXO survey performed, if applicable.	☐	☐	☐	
2. Public utility markings are present for all utility companies notified. List the companies with public utilities present on-site and cross check with expected utilities and on-site indicators:	☐	☐	☐	
Natural gas/oil/petroleum lines and associated tanks:	☐	☐	☐	
Electric:	☐	☐	☐	
Potable water pipes, hydrants:	☐	☐	☐	
Sewers (storm/process water/sanitary) and/or Manways/Grates/Culverts:	☐	☐	☐	
Public lighting (street and traffic):	☐	☐	☐	
Telephone and Data Lines:	☐	☐	☐	
Other underground utilities:	☐	☐	☐	
3. Private utilities marked and scope discussed with/provided to locator	☐	☐	☐	Subcontractor Name: Contact #:
Alternate intrusive locations chosen in case of refusal or presence of utilities/indicators in Critical Zone	☐	☐	☐	
Describe nonconformity or unexpected conditions found by locator	☐	☐	☐	
4. Site Walkover performed to confirm utility markouts and assess the presence of Visual Indicators. If visual indicators are present, note location in comments/Plot Plan:	☐	☐	☐	
Indication of underground storage tank/piping and dispense islands	☐	☐	☐	
Non-native soils, surface depressions, new/dead vegetation	☐	☐	☐	
Saw cuts, patched surfaces, warning tape or other surficial indicators of below ground work	☐	☐	☐	
Pumps, pump galleries, piping manifolds and/or racks, process equipment, compressors, etc.	☐	☐	☐	
On or below-grade transformers	☐	☐	☐	
Fuel oil lines, tanks, fill ports, observation wells, vent stacks, hydraulic lift systems	☐	☐	☐	
Adjacent/supplemental buildings with no apparent utility feeds (electricity, water, gas)	☐	☐	☐	
Other:	☐	☐	☐	
5. Plot Plan updated to reflect most accurate site SSC information. Describe any on-site additions/changes	☐	☐	☐	
6. Ground Disturbance location(s) and Critical Zones (5ft/1.5m distance in every horizontal direction surrounding disturbance locations) cleared of utilities and visual indicators	☐	☐	☐	Contact PM and HSS Director if utilities pass through the Critical Zone of a planned ground disturbance location
A mark has been placed on each intrusive location and radial marks extending to the edge of the Critical Zone	☐	☐	☐	
Intrusive locations and Critical Zones cleared of utilities using sweep and search method or other applicable SSC investigative methods.	☐	☐	☐	
Once evaluated and cleared of utilities, intrusive locations cannot be moved and a Critical Zone must be maintained around the locations	☐	☐	☐	
Alternative intrusive locations used due to obstructions within Critical Zone. Describe abandoned and alternative locations	☐	☐	☐	
7. Pre-start HSS meeting conducted and SSC risk/hazards discussed	☐	☐	☐	
Locate results and intrusive locations/Critical Zones understood by all parties involved	☐	☐	☐	

Form completed by _____ _____ _____

Name Date Signature

ATTACHMENT C
ONE CALL AGENCY CONTACTS

UNCONTROLLED WHEN PRINTED

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
811 Dig Safe (MA, ME, NH, RI, VT)	811
Alabama Alabama 811 www.al811.com	811 or 1-800-292-8525
Alaska Alaska Digline, Inc. www.akonecal.com	811 or 1-800-748-3121
Arizona Arizona Blue Stake www.azbluestake.com	811 or 1-800-782-5348
Arkansas Arkansas One Call	811 or 1-800-482-8998
California (North) Underground Service Alert of North www.usanorth.org	811 or 1-800-227-2600
California (South) Underground Service Alert Dig Alert www.digalert.org	811 or 1-800-227-2600
Colorado Colorado 811 www.co811.org	811 or 1-800-922-1987
Connecticut Call Before You Dig www.cbyd.com	811 or 1-800-922-4455
Delaware Miss Utility of Delmarva www.missutilitydelmarva.com	811 or 1-800-282-8555
District of Columbia District One Call www.missutility.net	811 or 811 or1-202-265-7177
Florida Sunshine Sate One Call www.callsunshine.com	811 or 1-800-432-4770
Georgia Georgia 811 www.georgia811.com	811 or 1-800-282-7411
Hawaii Hawaii One Call www.callbeforeyoudig.org	811 or 1-866-423-7287

UNCONTROLLED WHEN PRINTED

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
Idaho Pass Word Dig Line, Inc. www.digline.com	811 or 1-800-342-1585
Idaho (Bonner/Boundry) Pass Word www.passwordinc.com	811 or 1-800-626-4950
Idaho (Kootenai County) Pass Word www.passwordinc.com	811 or 1-800-428-4950
Idaho (Shoeshone-Benewah) Pass Word www.passwordinc.com	811 or 1-800-398-3285
Illinois (Outside of Chicago) Julie www.illinois1call.com	811 or 1-800-892-0123
Illinois (Chicago) Digger – Chicago Utility Alert Network egov.cityofchicago.org	811 or 1-312-744-7000
Indiana Indiana 811 www.indiana811.com	811 or 1-800-382-5544
Iowa Iowa One Call www.iowaoncecall.com	811 or 1-800-292-8989
Kansas Kansas One Call www.kansasonecall.com	811 or 1-800-344-7233
Kentucky Kentucky 811 www.kentucky811.org	811 or 1-800-752-6007
Louisiana LA One Call www.laonecall.com	1-800-272-3020
Maine Dig Safe www.digsafe.com	811 or 1-888-344-7233
Maryland (West of Chesapeake Bay) Miss Utility of Maryland www.missutility.net	811 or 1-800-257-7777

UNCONTROLLED WHEN PRINTED

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
Maryland (East of Chesapeake Bay) Miss Utility of Delmarva www.missutilitydelmarva.com	811 or 1-800-282-8555
Massachusetts Dig Safe System, Inc. www.digsafe.com	811 or 1-888-344-7233
Michigan Miss Dig www.missdig.org	811 1-800-482-7171
Mississippi Mississippi 811 www.ms811.org	811 or 1-800-227-6477
Missouri Missouri One Call System www.mo1call.org	811 or 1-800-344-7483
Montana Montana 811 www.montana811.com	811 or 1-800-424-5555
Montana (Flathead and Lincoln Counties) Montana Once Call Center www.udig.org	811 or 1-800-551-8344
Nebraska Diggers Hotline of Nebraska www.ne-diggers.com	811 or 1-800-331-5666
Nevada USA North www.usanorth.org	811 or 1-800-227-2600
New Hampshire Dig Safe System, Inc. www.digsafe.com	811 or 1-800344-7233
New Jersey New Jersey One Call www.nj1-call.org	811 or 1-800-272-1000
New Mexico New Mexico One Call, Inc. www.nmonecall.org	811 or 1-800-321-2537
New York (North of 5 Boroughs) Dig Safely New York www.digsafelynewyork.com	811 or 1-800-962-7962

UNCONTROLLED WHEN PRINTED

One-Call Agency Contacts	
Agency	**Phone Number**
United States	
New York (5 Boroughs and Long Island) New York 811, Inc. www.newyork-811.com	811 or 1-800-272-4480
North Carolina North Carolina 811 www.nc811.org	811 or 1-800-632-4949
North Dakota North Dakota One Call www.ndonecall.com	811 or 1-800-795-0555
Ohio Ohio Utilities Protection Service www.oups.org	811 or 1-800-362-2764
Oklahoma Call Okie www.callokie.com	811 or 1-800-522-6543
Oregon Oregon Utility Notification Center www.digsafelyoregon.com	811 or 1-800-332-2344
Pennsylvania Pennsylvania One Call System, Inc, www.paonecall.org	811 or 1-800-242-1776
Rhode Island Dig Safe System, Inc. www.digsafe.com	811 or 1-888-344-7233
South Carolina South Carolina 811 www.sc811.org	811 or 1-888-721-7877
South Dakota South Dakota One Call www.sdonecall.com	811 or 1-800-781-7474
Tennessee Tennessee 811 www.tennessee811.com	811 or 1-800-351-1111
Texas Texas811 www.texas811.org	811
Utah Blue Stakes of Utah www.bluestakes.org	811 or 1-800-662-4111

UNCONTROLLED WHEN PRINTED

One-Call Agency Contacts

Agency	Phone Number
United States	
Vermont Dig Safe System, Inc. www.digsafe.com	811 or 1-888-344-7233
Virginia Virginia 811 www.va811.com	811 or 1-800-552-7001
Washington Utility Notification Center www.callbeforeyoudig.org	811 or 1-800-424-5555
West Virginia Miss Utility of West Virginia www.muwv.org	811 or 1-800-245-4848
Wisconsin Diggers Hotline www.diggershotline.com	811 1-800-242-8511
Wyoming One-Call of Wyoming www.onecallof wyomng.com	811 or 1-800-849-2476
Australia	
Dial Before You Dig (Australia)	1100
Canada	
Alberta Alberta One Call www.alberta1call.com	1-800-242-3447
British Columbia BC One Call www.bconecall.bc.ca	1-800-474-6886
Manitoba Call Before You Dig www.callb4udig.mb.ca Does not complete locate requests, but provides a list of utility companies	Various
Ontario Ontario One Call www.on1call.com	1-800-400-2255
Quebec Info Excavation www.info-ex.com	1-800-663-9228

UNCONTROLLED WHEN PRINTED

One-Call Agency Contacts	
Agency	**Phone Number**
Saskatchewan Sask 1st Cal www.sask1stcall.com	1-866-828-4888
United Kingdom	
National One-Call (United Kingdom)	0844 800 9957

UNCONTROLLED WHEN PRINTED

ATTACHMENT D
ANATOMY OF UTILITIES

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ANATOMY OF UTILITIES

GENERAL

Although the different utility systems (i.e., electrical, natural gas, water, cable television, and telephone) provide different types of services, how these services get from the producer to the end user aren't so different. In order to create, capture, transport, and distribute their product to the customer, all utility systems must follow the same process, each must:

1. Build "It" up or light "It" up - this is production or generation; then
2. Push "It" through – transmitting the utility through lines or pipes; then
3. Take "It" down or "change "It" around" – at substations, from one big line to many smaller lines; and lastly
4. Break "It" down – distributing the utility to the end user.

The "It" can only be one of 4 things:

- Electrons
- Gases
- Photons
- Liquids

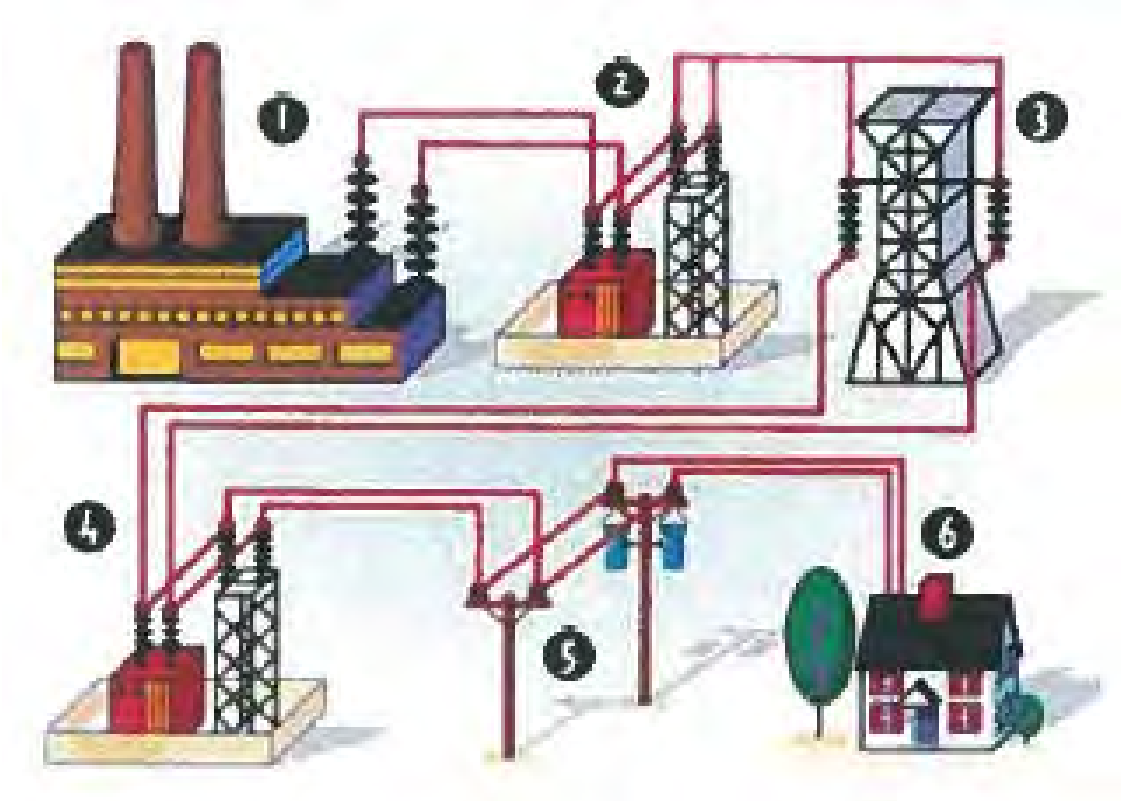
In general, the terms "transmission", "feeder", and "distribution" are the stages for the delivery of utility products (i.e., electricity, natural gas, water, and telecommunications). And in order for the utility company to deliver their products or "push" their products to the customer, they must "build up" their product in order for the product to move. For example, to get electricity to flow over a long distance, the voltage must be built up to flow. To transport natural gas and water a long distance, the pressure must be built up. This means that the product starts out under high voltage or pressure on reduces to a level that consumer products and devices can handle. Cable and television products slightly differ in their mode of transmission (i.e., they use a combination of electrons and photons. Nonetheless, all of these utilities have devices, equipment, and distribution items which, many times, are indicators that the respective utility is present in a particular area.

The intent of this attachment is two-fold: first, to quickly present how each utility works, and secondly but more important, what these devices, equipment, and distribution items look like so they can be left undistributed and/or be indicators that a specific utility is present.

UNCONTROLLED WHEN PRINTED

Electricity

Generally, when electricity leaves a power plant (1), its voltage is increased at a step-up substation (2). Next the energy travels along a transmission line where the power is needed (3). Once there, the voltage is decreased or stepped-down at another substation (4), and a distribution power line (5) carries the electricity until it reaches a home or business (6).



Build it up (Production)

The power plant houses electromagnetic generators and turbines, spun by steam or falling water, to produce three independent streams of electricity.

Step-up substations at the power plant use large transformers to greatly increase the generated voltage to transmission levels. A transformer can work in two ways:

1. Raise voltage while reducing current
2. Lower voltage while increasing current

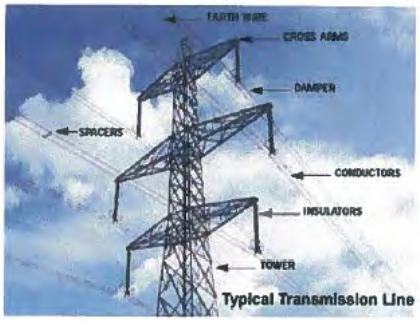
Transmission distances can be as great as 300 miles (483 km), so voltage is increased from 20kV to 500 kV to minimize power loss over the distance.

UNCONTROLLED

Push it through (Transmission)

Aerial high-voltage transmission lines are raised high into the air to prevent dangerous contact of any sort with the lines. They carry electricity at 500 kV and 230 kV. A by-product of flowing electrons (electricity) on a metal conductor is heat, and the winds at higher elevations cool the overhead line. Typically, the higher the transmission line, the higher the voltage.

To keep the current flowing on the conductor rather than into the towers, and then to earth, insulating arrestors are used. These are commonly made from porcelain, glass, or a polymer, and are composed of a series of disks that dissipate current over their surface area. The more disks the arrestor has, the higher the voltage on the line.



Take it down

While the voltage was dialed way up to travel, it must be dialed back down for use. The next stop is a power substation, where the high-voltage electricity comes off the transmission lines and is stepped down for distribution. Some large industrial users have so great a need for electricity that they're supplied directly from major transmission circuits.

At a transmission-fed substation or step-down substations, voltage is reduced from hundreds of kilo-volts to sub-transmission levels of 69 kV and 34.5 kV. Transformers, with the help of voltage regulators, circuit breakers, and capacitor banks, induce energy from a large coil to a small coil or set of coils to reduce the voltage. Transformers and circuit breakers are often filled with oil to help dissipate the heat produced by high voltage electricity passing through them.

1. Transformers have a series of fins on the rear that help aid in cooling them by pulling heat away, as more air contacts the surface area of the fins.
2. Voltage regulators can be stand-alone or mounted on the side of a transformer, and by constantly monitoring voltage, the voltage regulator automatically adjusts to keep the voltage at a pre-determined level.

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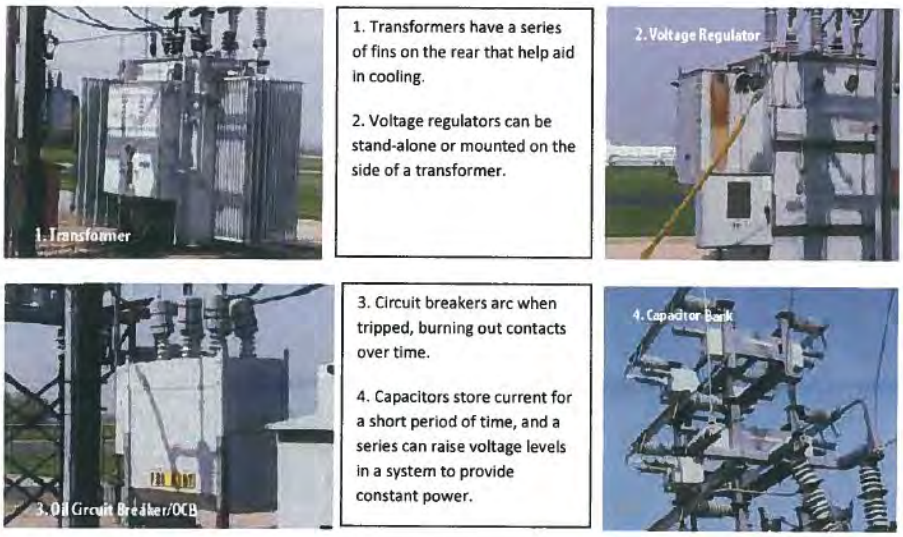
3. Circuit breakers arc when tripped, burning out contacts on the switch over time.
4. Capacitors store current for a short period of time, and a series of capacitors can raise voltage levels in a system to provide constant power.



From a part of the substation called the “bus,” sub-transmission lines are split out and re-directed into multiple directions. These sub-transmission lines, also known as feeder circuits, feed substations that reduce the voltage to distribution voltages, such as 13.2 kV, 12.8 kV, or 12.5 kV, or go directly to industrial or commercial users that require more power. The bus bars connecting the capacitors are not insulated, and can contain tens-of-thousands of volts.

Sub-transmission lines can be aerial or underground. Lines that transition from aerial to underground require an insulator commonly referred to as a pothead, or potential head, which reduces the electrostatic energy on the line.

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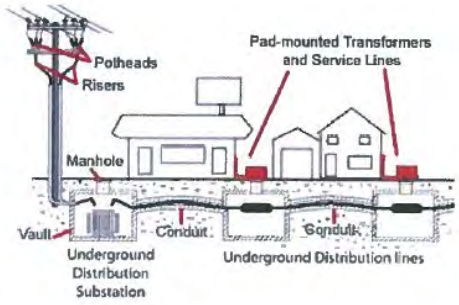
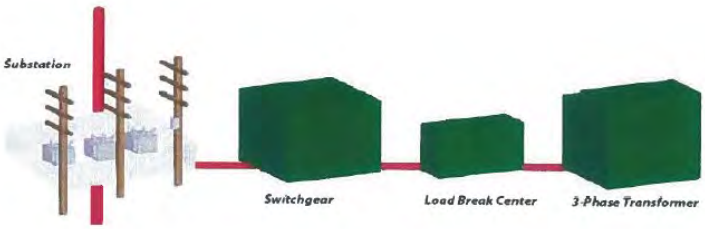


Break it down (Distribution)

3-Phase Users

The 3-phases leaving the substation are called primary cables, and they travel towards end users with a few transitional points along the way.



The first structure where a transition may occur is at a switchgear, or switching cubicle, which changes the path of current flow. A switchgear consists of a series of switches connected in a loop that can be used to rearrange the path of current flow for issues like repairs to be completed on a distribution line, without a major service disruption.

The next structure downstream of a switchgear is called a load break center, or LBC. Its function is to branch out the direction of current flow.

Everything in the electrical system is interconnected. On the left of the picture above, a large diameter 3-phase cable, a bulk feeder, enters and exits a switchgear to feed a smaller diameter cable that will serve customers. The bulk feeder cable continues on to do the same thing at the next enclosure.

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In the middle of the series of pictures above, you see an LBC directly in-line with the switchgear in the background. Electrical cables run from one structure to the next as voltage is broken down and distributed to the end user. The final structure one may encountered before reaching the end user is a transformer, on the right. At a 3-phase transformer, the primary cables enter on the left side, and a secondary cable headed to the customer exit at the right side.

Break it down (Distribution)

Single Phase Users

As electricity leaves the substation, it travels on 3-phase cables. Single-phase begins by tapping into one of the three phases. A single-phase tapped from a 12.5 kV 3-phase is typically 7,200 volts. A single-phase transformer decreases the 7,200 volts down to the 120 or 240 volts, which is needed for residential use.

On the left of the figure below, two single-phase cables are tapped from a 3-phase. On the right, a single=phase transitions from aerial to underground, often called a pole drop.

The distribution electricity is reduced to the end use voltage of 120 or 240 volts by a pole-mounted or pad-mounted transformer. Then, power is delivered to the residential customer through a service drop line that leads from the pole transformer to the customer's structure, for both overhead and underground lines.

A single-phase transformer is much smaller than a 3-phase transformer and typically has a hinged lid rather than a door in the front.

These pad-mounted transformers (shown in the figure below) are fed from an underground line and can produce multiple secondary voltage services going in multiple directions.

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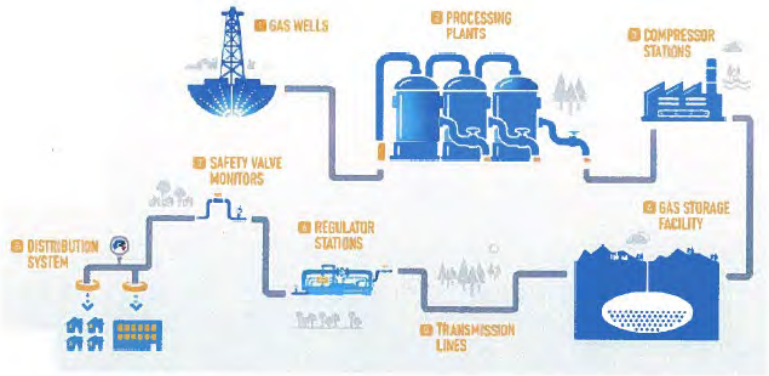
In addition to single-phase transformers, several other secondary enclosures, as shown in the figures below, serve as junction boxes where a large secondary cable is broken down into several smaller secondary cables.

UNCONTROLLED WHEN PRINTED

Natural Gas

Deep wells extract natural gas deposits and deliver the gas to processing plants where heavier hydrocarbons like butane, propane, and ethane are removed. The resulting methane-rich gas moves from the processing plant to the local natural gas utility company through what could be up to a 150,000-mile (241,402 km) network of underground pipes, made mostly of high-strength steel.



Build it up (Production)

Once it leaves the processing plant, natural gas must be compressed and brought up to pipeline pressure, as high as 1,900 psi (98,259 mmHg). Compressor stations are located approximately every 70 miles (113 km) along the transmission line superhighway to pressurize the gas and keep it moving at approximately 15 miles per hour (24 km/hr).

Excess natural gas, unlike electricity, can be stored for use when demand is high, like in the winter. Natural gas is stored along the pipeline route in large geological formations.

Push it through (Transmission)

While some larger industrial, commercial, and electric companies receive natural gas from inter and intrastate pipelines, most other users receive it from their local gas utility. Gate stations are where a transmission pipeline company sells its gas to a local distribution company, or LDC. Regulators and metering instruments are used to monitor flow. At this point, the gas is odorized with mercaptans and sulphides to create the distinct rotten egg odor that serves an indication of natural gas leakage.

UNCONTROLLED WHEN PRINTED

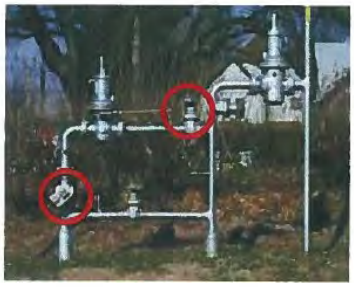
Take it down

Pressure is reduced from transmission levels to distribution levels at gate stations. The gas is passed into beltlines, also known as feeder or transfer lines, which are the highest pressure mains found in the distribution system. Beltlines are generally built to form a rectangle or loop, with no beginning or end, and serve as feeders to district regulator stations.

Beltlines loop together a series of distribution regulator stations and maintain the necessary station-to-station pressure to ensure ample pressure to all parts of the system. Because beltlines are looped, beltline valves can be closed to isolate a segment of the pipeline without shutting down an entire station.

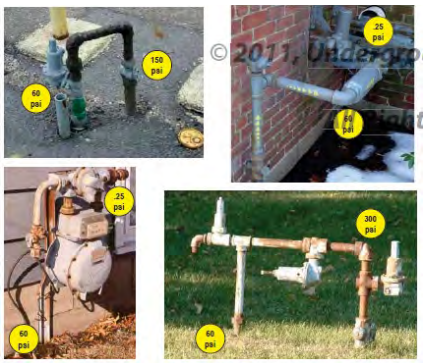
Beltline valves may be aboveground, while the beltline system is underground. Beltlines that traverse under busy roads or railways are protected by steel casings and have vent pipes to allow for quick detection of leaks

From the gate station, natural gas moves into distribution lines. Generally, the closer the natural gas gets to a customer, the smaller the pipe diameter and the lower the pressure. Regulators control the pressure within each distribution system by opening or closing when gas pressure drops below or rises above a predetermined level.



Break it down (Distribution)

Service regulators reduce the pressure so it's usable inside the customer's premises. One regulator on the service indicates the inlet pressure is 60 psi (3,103 mmHg), or less. Two regulators on the service line indicate that the inlet pressure downstream of the service tap on the main is greater than 60 psi (3,103 mmHg).



Gas distribution mains are frequently interconnected, forming a grid system. Given that gas in this grid system can flow two ways, main valves can be shut so that parts of the distribution system can be isolated for maintenance without interrupting service to customers.

When gas main leaks occur and closing valves is not a strategically viable option, the gas flow can be stopped by applying an “as needed” solution. The type of gas stoppage solution used is dictated by the size and type of pipe.

The hydrostatic pressure of ground water is greater than the gas pressure in a low pressure system, permitting water ingress into the piping system if the system is damaged. Water is pumped to the surface at drips, gravity-fed reservoirs attached to low pressure pipes.

Original low pressure systems typically consisted of cast iron mains and uncoated bare steel services, which corroded over time.

UNCONTROLLED WHEN PRINTED

Curb valves, like this one in the middle figure above, are typically installed near property lines, creating an emergency shut off option in an easement away from the property. Low pressure systems utilize larger pipes, such as this pipe exiting a regulator station, in order to compensate for volume that cannot be supplied by the low pressure.

A service regulator isn't needed in a low pressure system since the pressure in the main is what's used inside the customer's premises. In addition, the service pipe needs to be of larger diameter to provide the volume of gas needed for customer demand. Since a regulator is a safeguard against unintended increases in pressure, low pressure systems are inherently more dangerous due to the absence of a regulator on the customer's premises.

UNCONTROLLED WHEN PRINTED

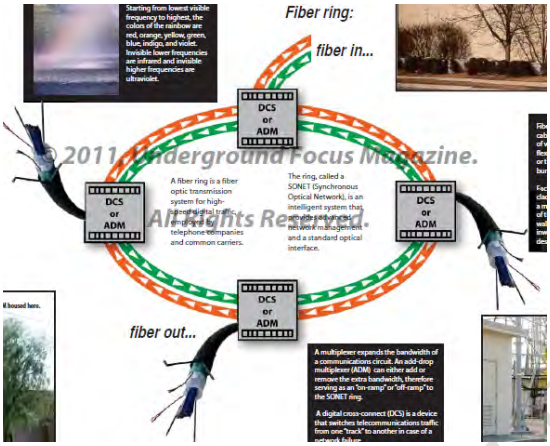
Fiber optics

Fiber serves as the backbone for telephone, cable television, and the internet. Fiber is made of very pure glass, remarkably strong, yet flexible and bendable like a wire. Hundreds or thousands of fibers can be arranged in bundles, called an optical cable.

Each strand of a single fiber is covered by cladding, a protective coating made from a material that reflects light into the center of the cable. Cladding creates a mirror-lined wall that allows light to reflect and bounce inwards, traveling around corners to its destination.

Light it up

A fiber ring is a fiber optic transmission system for high-speed digital traffic employed by telephone carriers. The ring is called a SONET (Synchronous Optical Network) and provides advanced network management and a standard optical interface.



The capacity of a fiber optic cable is quantified by its bandwidth. A rainbow reveals optical bandwidth. A multiplexer expands the bandwidth of a communications circuit. An add-drop multiplexer (ADM) can either add or remove the extra bandwidth, therefore serving as an “on-ramp” or “off-ramp” to the SONET ring.

A digital cross-connect (DCS) is a device that switches telecommunications traffic from one “track” to another in case of a network failure.

CONTROLLED WHEN PRINTED

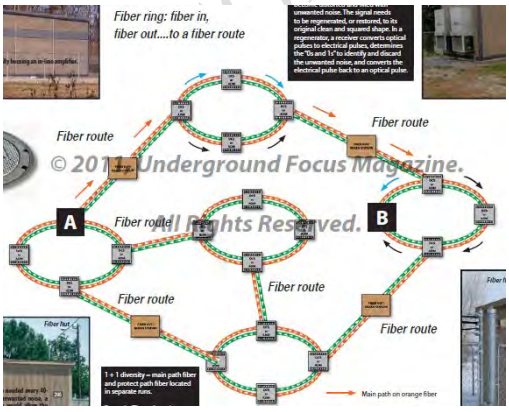
Fiber cable exits cell sites and heads to DCS or ADM, as shown in the figures below.

DCS and ADM are housed in facilities like these shown in the figures below.

Push it through

Photons—Electrons—Photons

Digital signals become distorted and filled with unwanted noise during transmission. In a regenerator, a receiver converts optical pulses to electrical pulses, identifies and discards the unwanted noise, and converts the electrical pulse back to an optical pulse.



CONTROLLED WHEN PRINTED

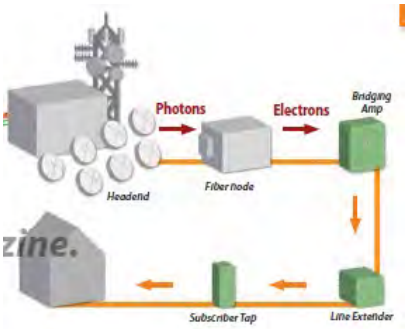
A fiber hut, or regeneration center, houses an in-line amplifier. Regeneration centers are needed every 40-60 miles (64-97 km). By removing unwanted noise, a cascade of regeneration centers would allow the signal to continue on forever.

UNCONTROLLED WHEN PRINTED

Cable TV

The physical makeup of a cable television (CATV) system is known as a Hybrid Fiber Coaxial (HFC) network. Fiber runs deep into the distribution system, terminating at fiber nodes located near clusters of customers. Photons are converted into electrons at a node. A low electrical signal exits the node and is pushed onto large diameter coaxial cables, termed trunk cables.

The trunk system loops the service area, feeding bridging amplifiers along the way. At a bridging amplifier, the electrical signal is raised up (amplified) for distribution onto smaller diameter coaxial cables, known as feeder cables, which are then tapped into for delivery to the customer.



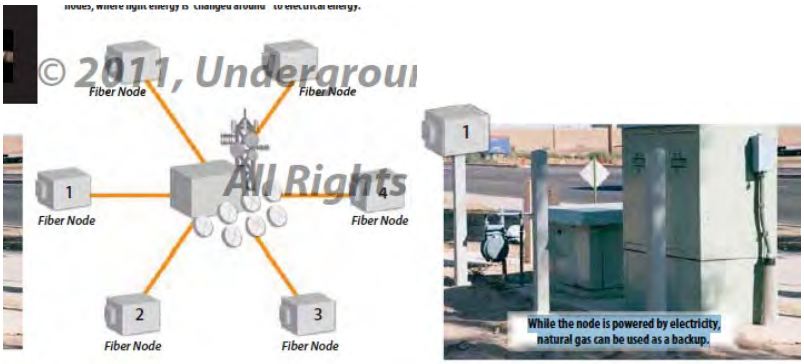
Change it around

A fiber node, or an optical receiver, converts light into electrical energy. Light comes into the node and is "changed around" into electricity. The act of changing light into electricity cannot be done without electricity.

Cable television signals are received from space satellites at dish-shaped antennas on Earth, an origination point called the headend. Programming signals received at the headend are assigned to channels and begin their transmission to the end user via fiber optic or copper coaxial cable.

Today, most feeds from a headend are fiber cables running to fiber nodes, where light energy is "changed around" to electrical energy.

UNCONTROLLED WHEN PRINTED



(1) While the node is powered by electricity, natural gas can be used as a backup.

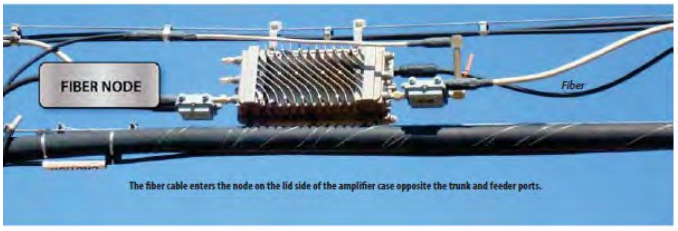
(2) A power supply is pictured with this curb-side fiber node. A fiber optic line feeds the node and terminates, as traditional coaxial cable exits the node providing last mile (km) service to the surrounding neighborhood. A node serves several hundred customers in a radius of 5000 feet (1524 m), providing broadband services like high-speed internet.

Supplied by secondary voltage, a power supply drops the voltage to 90 volts. To provide power to downstream amplifiers, the AC current is placed on the cable and converted to DC current at each amplifier.

(4) The trunk system begins in a vault, like the one shown in the figure above.

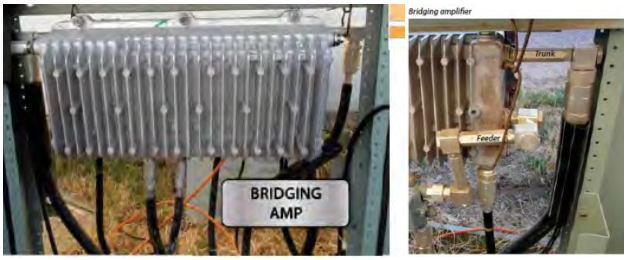
A trunk system's origin is at the fiber node. The coaxial trunk cable serves the CATV feeder system much like the sub-transmission feeder serves the electric distribution system and the beltline serves the gas distribution system.

The fiber cable enters the node on the lid side of the amplifier case opposite the trunk and feeder ports.



Build it up / Break it down

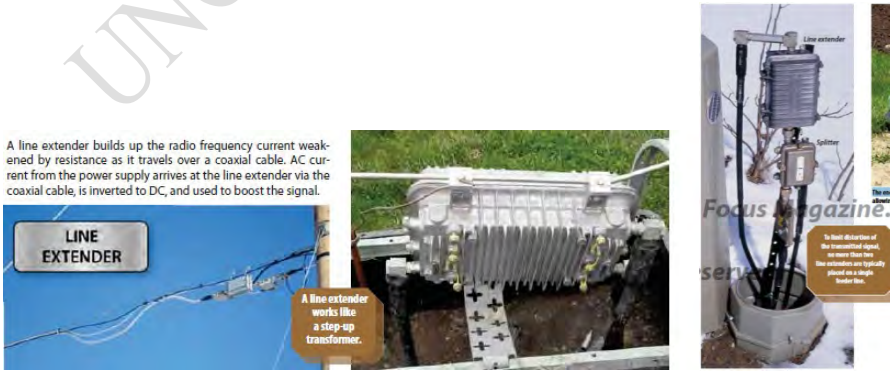
Bridging amplifiers tap low-powered trunk signals and convert them to high-powered feeder signals. Within each bridging amp is a directional coupler, a passive device that induces the transfer of energy from the trunk system to the feeder system.



Coaxial trunk cables are larger than coaxial feeder cables because larger diameter cables experience less signal loss than smaller cables, resulting in the need for fewer amplifiers. Trunk lines need amplification every 1,500-2,200 feet (457-671 m) while feeder lines need more frequent amplification.

A coaxial cable has two conductors, the central copper wire, known as the inner conductor or “stinger”, and an aluminum tubular shield, known as the outer conductor. At any moment, the current is traveling outward from the source on one of the conductors while returning on the other. This type of construction prevents power losses by reducing the production of an electromagnetic field.

A line extender works like a step-up transformer and builds up the radio frequency current weakened by resistance as it travels over a coaxial cable. AC current from the power supply arrives at the line extender via the coaxial cable, is inverted to DC, and used to boost the signal.



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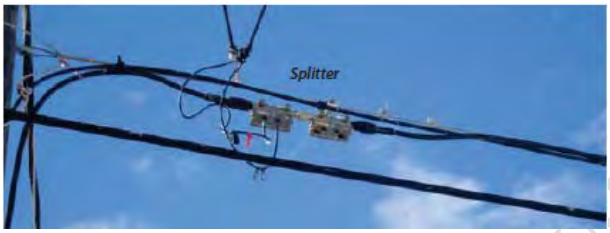
The enclosures that house amplifiers are vented, allowing heat produced by the amplifier to escape.



When it comes to feeder cables, splitters may send more signal to one route over that of another, such as a 60/40 split of the signal.

Subscriber taps transfer signal from the feeder cable to the customer's premises.

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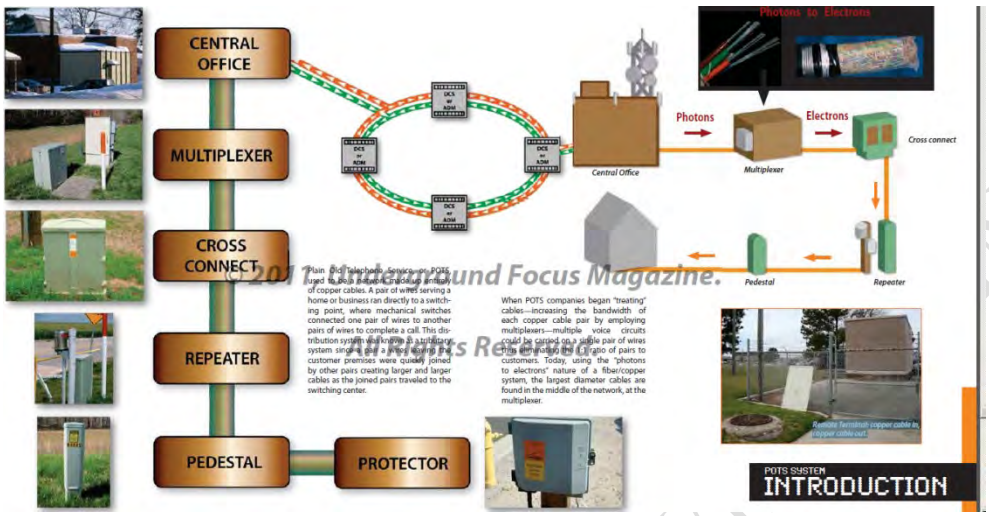
Telephone

Plain Old Telephone Service, or POTS, used to be a network made up entirely of copper cables. When POTS companies began "treating" cables, or increasing the bandwidth of each copper cable pair by employing multiplexers, multiple voice circuits could be carried on a single pair of wires. Today, using the "photons to electrons" nature of a fiber/copper system, the largest diameter cables are found in the middle of the network, at the multiplexer.



Remote Terminal: copper cable in, copper cable out is shown in the figure below.

Light it up

A central office, or CO, is a telephone company building housing switching equipment and is considered the "brains" of a telephone system. The switching equipment generally serves up to 100,000 customer lines within a geographical area known as an exchange, or wire center.

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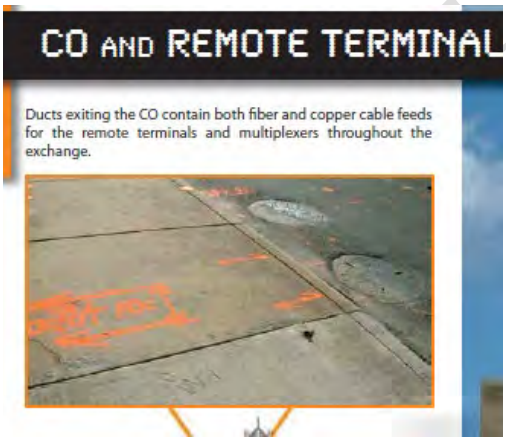
The CO connects to downstream remote switching sites with either copper or fiber cables, although today newly constructed feeds are exclusively fiber. A toll cable connects a CO to another CO, while a carrier cable connects the CO with remote switching equipment.

The term “carrier” denotes that the cable’s function is within a single exchange.

Ducts exiting the CO contain both fiber and copper cable feeds for the remote terminals and multiplexers throughout the exchange.



Connected by a carrier cable to the CO, a remote terminal (RT) is a “mini CO” that brings switching and multiplexing functions closer to the customer, creating greater copper cable functionality between the RT and the customer.

A copper carrier cable is a “treated” cable, or multiplexed cable, meaning that the bandwidth has been multiplied.

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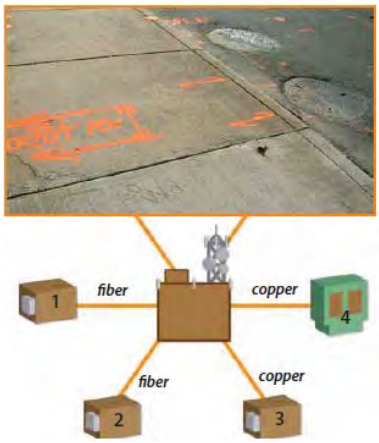
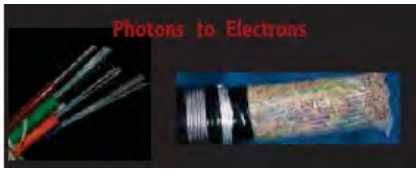


Change it around

Multiplexers perform switching functions identical to those performed at the central office. The fiber or copper carrier circuit connects the CO with the multiplexer. Equipment at the CO and at the multiplexer assign circuits to specific bandwidths of the carrier cable. These unique frequencies are then assigned to specific copper pairs at the multiplexer.



The act of changing light into electricity cannot be done without electricity provided by the power company.

Types of equipment found at multiplexer sites:

- SLC: Subscriber Loop Carrier
- DLC: Digital Loop Carrier
- DSLAM: Digital Subscriber Line Access Multiplier
- VRAD: Video Ready Access Device

A VRAD can serve 200–400 households, depending on its configuration.

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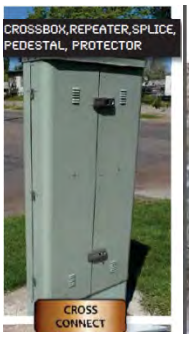
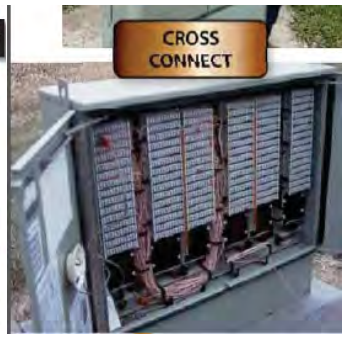
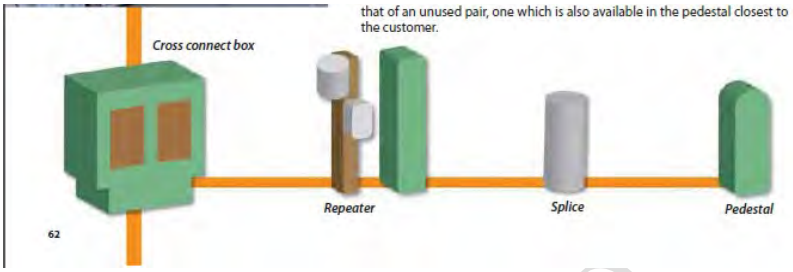
Build it up / Break it down

A feeder cable enters a cross connect box, or crossbox, and one or more distribution cables exit the crossbox. Inside the crossbox is a large panel with punch-down blocks. Ends of feeder pair wires are connected to beginnings of distribution pair wires using the punch-down blocks and orange and white-ended tin jumpers.







Single copper wire telephone circuits, known as a pair, utilize a ten-color code in order to identify the circuit on each end of the line, such as at a crossbox and downstream at a splice point or pedestal.

Because a signal loses quality and strength over distance on a copper system, an electronic device called a repeater is used at regular intervals to boost and amplify the signal. A repeater can regenerate a digital signal, cleaning it up and removing noise for retransmission.

A splice cabinet generally has one entrance cable and two exit cables, such as a 300-pair entrance and a 200-pair exit and a 100-pair exit.

A pedestal houses cables coming in, cables going out, and cables spliced together. A copper circuit, known as a pair, originating at a CO, remote terminal or multiplexer is diverted to the customer premises at a pedestal.

The point where the telephone company's service lines meet the subscriber's wiring or protective equipment is a network interface. The network interface is located on the customer's side of the phone company's protector.

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ATTACHMENT E
UNDERGROUND LOCATING EQUIPMENT

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COMMON TYPES OF LOCATOR EQUIPMENT

Due to specific site conditions, no single method of locating subsurface utilities is universally fail proof. Surface and subsurface conditions may interfere with the effective use of specific utility locating technology. Following is a discussion of some technologies available and the relative merits of each.

1. Radio Frequency/Electromagnetic Detection

The radio frequency or electromagnetic technique locates buried materials having a high conductance (e.g., steel and copper). Examples of these utilities include water, natural gas, fuel lines, electricity and telephone. When installed with a metallic tracer wire, plastic pipes made of materials such as polyethylene and PVC, are also easily located.

Electromagnetic utility locators comprise a transmitter coil used for applying an electromagnetic signal and a receiver used to pick up that signal. Alternating electromagnetic waves generated at the surface are induced into the ground or directly injected into the utility during the survey. When the waves pass through a conducting body, they induce an alternating electrical current in the conductive materials. These currents become the source of secondary magnetic fields, which can be detected at the surface by the antennas in the receiver.

Picture 1: A locator searching for a conductive signal.

Picture 2: Signal transmitted to reciever.

These instruments typically utilize frequencies between roughly 400 hertz and 480 kilohertz. Lower frequencies tend to remain on the target utility better than higher frequencies, which have the tendency to “bleed over” onto adjacent conductors, causing errors and distortions. Similarly, aboveground or buried metallic structures, such as USTs, metal fences, and/or vehicles parked nearby, can also interfere with readings.

Direct connection (conduction) is the preferred method for locating utility lines. The transmitter is placed next to an access point for the target line being traced (typically attached to a valve, utility box, or other point where direct contact with the line can be made). A connection lead from the transmitter is connected to the target line and the second lead is connected to the ground. The transmitter is then adjusted for frequency and power output to match the properties of the target line, surrounding soil and other utilities nearby. Application of the correct frequency is essential to prevent electromagnetic coupling. The receiver is then set to the same frequency as the transmitter, gain control adjusted accordingly, and the signal is traced and marked on the surface.

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Photo 3: Direct connection to gas service tracer wire

Ring clamp induction is used to induce a signal onto an individual cable or conduit where direct connection is not an option. A ring clamp is connected to the transmitter and clamped around desired pipe or cable. The signal then travels from the transmitter to a coil within the clamp and onto the target line. The same care should be used in setting the correct frequency and gain as with direct connection.

Photo 4: Ring clamp induction

Induction is used when there is no surface access to the target line. Induction is the least desirable method of electromagnetic locating due to the massive amount of electromagnetic coupling or bleed off that is created from other inductive structures in the area. This method is also used to perform an inductive search to locate unknown or abandoned lines. The transmitter is placed on the surface, and over the point where the target line is thought to run. Once the target is located, it is traced with the receiver using the same method as direct connection.

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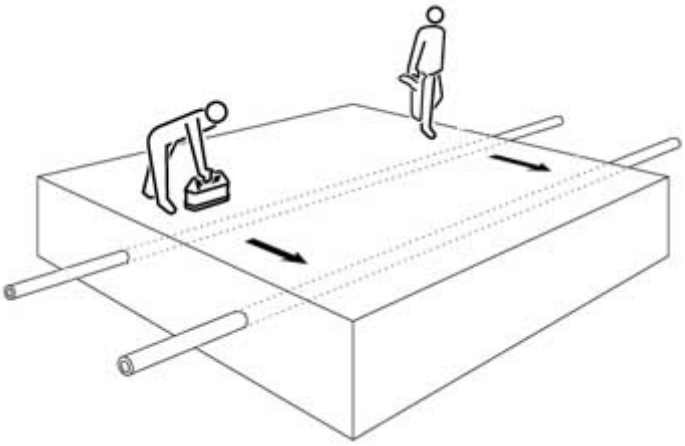

Photo 5: Inductive search

By detecting the maximum signal strength at several locations, the surface trace of an underground utility can be determined. The strength of the field is directly proportional to the average conductivity of the subsurface materials. If infrastructure made of non-conductive materials, such as concrete, asbestos, plastics, or clay needs to be found, electromagnetic locating instruments will only be effective if a metallic trace line was installed with the utility.

Detection depth of EM instruments is a function of the transmitter-to-receiver coil separation and the coil orientation (horizontal or vertical). Small coil separations, as in metal detectors and pipe locators, may reveal objects at depths between 2 and 6 feet below the ground surface.

Soil conditions have a large effect on how well electromagnetic locating devices perform. Moist clay is the ideal operating condition for more Electromagnetic locating, as well as other soil conditions that promote conductivity. Dry, sandy soils are the worst conditions for electromagnetic locating.

2. Ground Penetrating Radar (GPR)

Ground Penetrating Radar (GPR) is similar to Electromagnetic locating in that both technologies use electromagnetic frequencies, but that is where their similarities end. GPR uses radar pulses to image the subsurface and detect the reflected signals. The scanning antenna of the GPR continuously transmits pulses of radar-frequency electromagnetic energy directly into the ground as it is towed along a survey profile. When this energy reaches an object or the interface of materials with differing dielectric properties, it echoes and is captured by the antenna's receiver. Computer software uses the frequency of pulses transmitted and the amount of time delay between transmitting pulses and receiving echoes to depict a continuous subsurface cross-section in real time.

Photo 6: Ground Penetrating Radar detection

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GPR can be used to locate both metallic and non-metallic objects, but the depth range and resolution are directly dependent on radar frequency, transmitted power, electromagnetic properties of the ground material, as well as to the shape and characteristics of the underground targets. Since the electrical properties of metallic tanks, pipes, and wastes are distinctly different from soil and backfill materials, metallic targets produce dramatic and characteristic reflections. Fiberglass, plastic, concrete, and terra-cotta targets as well as subsurface voids, rock surfaces, soil type changes and concentrations of many types of non-metallic wastes also produce recognizable, but less dramatic reflections.

The most common method of locating is cross and mark as you go. This method works well in favorable soils and uncluttered settings. The GPR cart is moved along in sweeps, perpendicular to the anticipated utility axis. When the GPR sensor crosses the utility, the image shows an arch. The top of the arch is the **estimated** position of the utility and the depth to the top of the arch is the **estimated** depth.

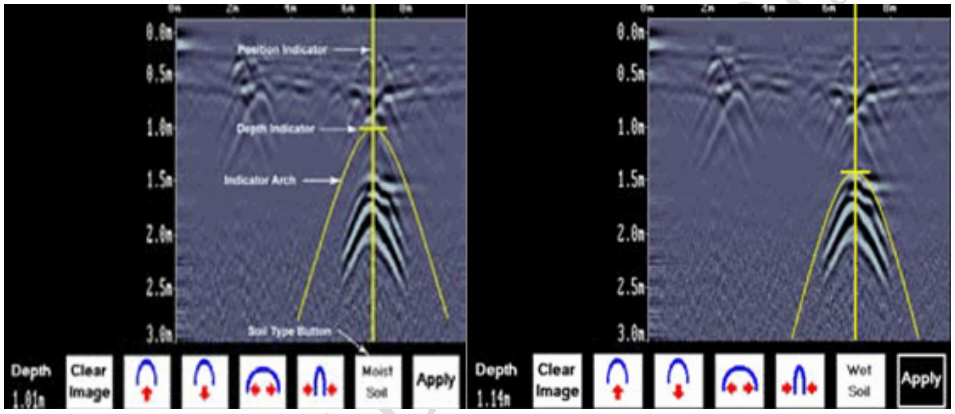

Photo 7: Screen shot of GPR

Although GPR has been applied at greater depths, it is generally considered to be more effective down to approximately 10-15 feet below ground surface in most lithologies, although this may vary greatly depending on location and composition bgs. Resolution is degraded with depths exceeding 20-30 feet.

Soil types and compaction of the soil determine visibility of unknown utilities. GPR works better in gravelly or sandy soil, and poorer in heavy clay materials. The efficiency of GPR is strongly affected by the target soil's conductivity (the soil's ability to carry a charge) and dielectric permittivity (the soil's capacity to hold a charge). Since different soils have different electrical characteristics, the effectiveness of GPR is highly dependent on the subsurface conditions at a particular site. For example, clay soils and subsurface brackish or salt water generally attenuate (absorb) the radar signal used by the GPR, thereby limiting its scan depth.

The best conditions for GPR are sandy or gravelly soils, such as silica sands, fresh water, ice, and most solid rocks of low conductivity. Maps that have been developed by the certain natural resource agencies (e.g., in the US, the Natural Resources Conservation Service) that show the relative suitability of soils for many GPR applications, can be found here: http://soils.usda.gov/survey/geography/maps/GPR/index.html.

The other main factor influencing GPR's maximum scan depth and resolution is the type of antenna used. Generally, the lower the antenna frequency the deeper the scan, but the lower the resolution –

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so only large objects will be detected. Conversely, a higher frequency antenna will give a shallower scan depth, but a much higher scan resolution, allowing for smaller subsurface features to be detected.

3. Vibrocators/Water Pipe Tracers

Vibrocators are used to detect and trace fluid-filled, non-metallic utilities (e.g., PVC or concrete water lines). A vibrocator system involves a low-frequency pressure wave generator called a transonde. The transonde is fitted to a faucet, hydrant, or other available fitting and the hand held receiver is used to trace buried pipe. The transonde produces a distinctive pressure wave signal along the pipe that is located by the seismic sensor in the receiver.

Photo 8: A vibrocator being demonstrated

Best performance is in locating a single pipe running under grass or verges. Locating may be reduced when the pipe runs under paving or concrete, as these materials dissipate the pressure wave signal causing the receiver peak response to spread over a wider area. Locate range may also be reduced at T-points or when the transmitter pipe joins a larger pipe, when the pressure wave signal can be split or reduced.

There are two limitations to this technology. One is that all non-metallic pipes to be traced must be available for connection directly to the transmitter. The second is that the excessive energy imparted to the pipe may cause damage.

4. Magnetic Metal Detection

Magnetic methods involve the measurement of anomalies in the earth's magnetic field. Anomalies are caused by induced or remnant magnetism. Induced magnetic anomalies are the result of secondary magnetization induced in a ferrous body by the earth's magnetic field. The shape and

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amplitude of these anomalies are a function of the orientation, geometry, size, depth, and magnetic susceptibility of the object, as well as the intensity and inclination of the earth's magnetic field in the area.

Magnetic locators will only locate metal objects that are made of ferrous material, like iron and steel utilities / facilities. It is an effective way to search for small metallic objects, such as buried ordinances, drums or utilities, because magnetic anomalies have spatial dimensions larger than those of the object themselves.

Photo 9: A metal detector being demonstrated

The depth in the ground at which a magnetic metal detector works depends on the mass of the object. A surveying nail can be detected to a depth of about 2-3 feet bgs (0.7 to 1m bgs), while an underground tank can be detected to a depth of about 15-17 feet bgs (5 to 5.6m bgs).

5. Vacuum Excavating

Small test holes are dug from the surface by vacuuming out soil, an activity commonly referred to as "potholing". This commonly follows more preliminary locating work to identify particularly difficult to trace utilities. It is also used when digging has been approved by the utility owner in the tolerance or critical zone of a particular utility to safely expose the line to excavate or sample in the surrounding area.

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Photo 10: A pothole exposing buried pipe

Photo 11: Vacuum excavation being demonstrated

Typically, vacuum excavation loosens the soil with a blunt-nosed high pressure air lance or water source and immediately vacuums away loosened material. Potholes are thus created, verifying the location and depth of a utility.

6. Subsurface Utility Engineering (SUE)

Subsurface Utility Engineering combines civil engineering, surveying and geophysics and utilizes several technologies, including vacuum excavation and surface geophysics. SUE is typically broken into four levels of quality pertaining to the methods, interpretation and precision of the subsurface utility data collected. These Quality Levels serve as a guide for engineers to determine the level of detail they require to map:

- Quality Level A: Designating & Location. Recommended during the design and construction phases.
- Quality Level B: Designation Only. Recommended during design stages and where utility records are generally unreliable.
- Quality Level C: Visible Features. Recommended during project planning stages to air site layout decisions.
- Quality Level D: Recommended for feasibility studies during the pre-design stage.

Photo 12: Subsurface Utility Engineering map

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ATTACHMENT F
COMMON UTILITY MARKINGS

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COMMON UTILITY MARKING

Utility mark out colors and identifiers may differ by area, region or country. Check local regulations prior to ground disturbance to ensure that all markings are clearly understood by the field staff. Following are some commonly used utility markings, as well as typical dimensions and identifiers:

American Public Works Association (APWA) Utility Color Codes

Color	*Fluid*
VERDE (RAL 6032)	**Acqua**
GRIGIO ARGENTO (RAL 9006)	**Vapore o Acqua surriscaldata**
AZZURRO	**Aria**
GIALLO OCRA (RAL 1024)	**Gas anche liquefatti (aria esclusa)**
GIALLO (RAL 1201)	**Fluidi pericolosi**
ROSSO (RAL 3000)	**Acqua Antincendio**
VIOLETTO	**Alcali**
ARANCIONE (RAL 2010)	**Acidi**
MARRONE (RAL 8007)	**Oli minerali, liquidi combustibili / infiammabili**
BIANCO	**Alta pressione**
NERO	**Altri Fluidi**

Italy: colors for industrial piping (ref. Technical Specification UNI 5634-1997):

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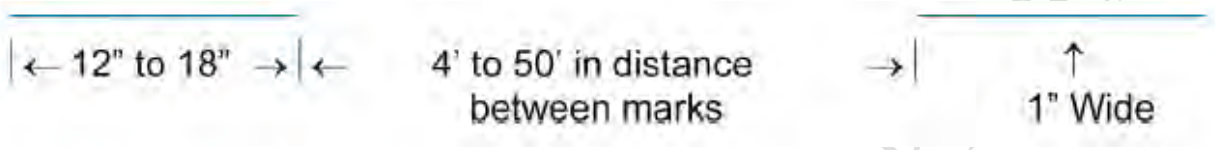
Each marking should approximately be of the following dimensions:

- Width of each marking line should be approximately 1 to 2 inches (2.5cm to 5.0cm)
- Length of each marking line should be 12 to18 inches (30cm to 40cm)
- Distance between marks depends on-site conditions, but between 4 feet (1.2m) and 50 feet (15.2m) apart (i.e., the utility locator will NOT use a continuous marking line but instead a dashed line to indicate the existence of an underground pipe and/or line). In the example below, the approximate location of a long running potable water line will be marked as follows:



Example of "Utility/Facility Identifiers" in the United States

Utility/Facility Identifier			
CH	Chemical	SS	Storm Sewer
E	Electric	SL	Street Lighting
FO	Gas	STM	Steam
G	Liquefied Petroleum Gas	SP	Slurry System
LPG	Petroleum Products	TEL	Telephone
PP	Railroad Signal	TS	Traffic Signal
RR	Sewer	TV	Television
S	Storm Drain	W	Water
SD		W	Reclaimed Water "Purple"
Underground Construction Descriptions			
C	Conduit	MH	Manhole
CDR	Corridor	PB	Pull Box
D	Distribution Facility	R	Radius
DB	Direct Buried	STR	Structure (vaults, junction box, inlet, lift station)
DE	Dead End		
JT	Joint Trench		Transmission Facility
HP	High Pressure	T	
HH	Hand Hole		
Infrastructure Material			
ABS	Acrylonitrile - Styrene	MTD	Multiple Tile Duct
ACP	Asbestos Cement Pipe	PLA	Plastic
CI	Cast Iron	RCB	Reinforced Concrete Box
CMC	Cement Mortar Coated		Reinforced Concrete Pipe
CML	Cement Mortar Lined	RCP	Reinforced Fiberglass
CPP	Corrugated Plastic Pipe		Steel Cylinder Concrete
CMP	Corrugated Metal Pipe	RF	Pipe
CU	Copper	SCCP	Steel
CWD	Creosote Wood Duct		Verified Clay Pipe
HDPE	High Density Polyethylene	STL	
		VCP	

The marking may also provide some of the following additional information:

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- Appropriate color for the utility (also referred to as a “Facility”) type;
- Total number of utilities / facilities of that type and their diameter;
- An abbreviation for the specific type of utility / facility present (e.g., HP, FO, STL,);
- Arrows would be provided if the line continues; and
- An End mark or a “T” would be present if the line ends.

Marking Samples

1. Electrical Duct Package: Red to represent electric, duct symbol represents multiple utilities running through a buried duct

2. 6” Natural Gas Line: Yellow to represent gas, straight line to symbolize a singular line

3. Termination Point of a Natural gas line: Yellow to represent natural gas, a T-shape to symbolize the termination location for the line

4. Offsets: Used when the marks cannot be placed directly above the buried utility / facility. In this case, a 6” gas line is located approximately 4 feet to the right from the marked line

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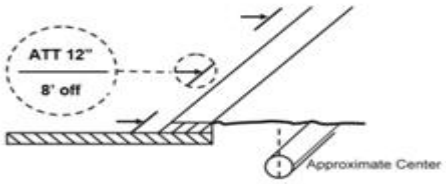

5. No Conflict: Red represents electric, “OK” symbolizes no utilities of this type are present on the site

6. Buried Splices, Valves, Manhole Lids with the circle diameter indicating approximate size of buried utility / facility

7. Street Lights: Red represents electric, combined with the SL symbol for street lights

8. Traffic Control: Red represents electric, combined with the TC symbol for traffic control

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APPENDIX D

FIRST AID GUIDANCE

Prepared By:
Ramboll Environment & Health
333 W. Wacker Drive, Suite 2700
Chicago, Illinois

Implementation Date

February 2011

Revision Date
February 2014

Version Number
2011 Version 5

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STANDARD PRACTICE INSTRUCTION 4

MEDICAL AND FIRST AID PROGRAM

RAMBOLL

STANDARD PRACTICE INSTRUCTION 4

IMPLEMENTATION DATE: February 2011

REVISION DATE: February 2014

SUBJECT: Medical and First Aid Program

BASIS: Hundreds of employees are injured in workplaces every day. Estimates are that the severity of most of these accidents can be reduced if prompt medical response is available and provided. This Standard Practice Instruction (SPI) establishes uniform requirements to ensure that a medical emergency response capability exists in Ramboll workplaces.

GENERAL: Ramboll will ensure that medical personnel are readily available for advice, consultation, and emergency response. In the absence of an infirmary, clinic, or hospital in near proximity to this workplace, which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid. First aid supplies shall be readily available that, at a minimum, conforms to ANSI Standard 308-1998 (see attachment A Minimum First Aid Supply List of this SPI), or equivalent. Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.

RESPONSIBILITY: The Directors of Health and Safety (the "Directors") are solely responsible for all facets of this program and has full authority to make necessary decisions to ensure success of the program. The Directors are the sole persons authorized to amend these instructions and are authorized to halt any operation of Ramboll where there is danger of serious personal injury.

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ATTACHMENTS

Attachment A: Minimum First Aid Supply List

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ACRONYMS AND ABBREVIATIONS

CPR	Cardiopulmonary resuscitation
Directors	Directors of Health and Safety
EMT	Emergency medical technicians
HASP	Health and Safety Plan
HSCs	Health and Safety Coordinators
PIC	Principal-in-Charge
PM	Project Manager
PPE	Personal protective equipment
SPI	Standard Practice Instruction

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1. WRITTEN PROGRAM

Ramboll will review and evaluate this SPI:

- On a triennial basis,
- When changes occur to the applicable regulation, and
- When there is an accident or close-call that relates to this topic.

This written program will be communicated to all personnel that are required to render first aid and/or cardiopulmonary resuscitation (CPR). It encompasses projects/areas where Ramboll is actively working, regardless of the number of workers employed or the number of work shifts. It is designed to establish clear goals and objectives.

2. FIRST AID RESPONSE ACTIONS

Ramboll considers medical and first aid services to mean access to trained personnel and appropriate equipment. The personnel can be located on site (as an employee or consultant of the company), or off site at community infirmaries, clinics, or hospitals. The services used must be staffed with medical professionals and equipped to handle the injuries and illnesses that might occur at a given facility, office, or worksite. Access to trained emergency medical technicians (EMTs) is also considered appropriate.

All personnel providing first aid and CPR training are also subject to Ramboll's Bloodborne Pathogen Program (See SPI 20).

A designated and recognized training provider (e.g., American RedCross, American Heart Association, or equivalent) certified first aid training and CPR training will be used to offer each Ramboll location training at least once every three years, as required by recognized training providers. Participation in such training will be required for site personnel and will be offered and open to all other employees.

Employers located beyond the definition of near proximity need to develop a first aid program to provide basic medical attention. This program should include the training of a sufficient number of employees in first aid (including bloodborne pathogens.) It also requires the employer to provide first aid supplies that have been approved by a physician familiar with the employer's operations. See Attachment A Minimum First Aid Supply List for a list of supplies Ramboll site personnel are required to take to client sites. These supplies must also be maintained at each Ramboll facility.

The following levels of first aid response will be used by Ramboll.

2.1 Basic first aid responders. For projects that involve intrusive sampling, visitation to the exclusion zones of hazardous waste sites, remediation operations, and/or by a client's site-specific requirements, Ramboll's "Site" or "Operations" employees will be trained to voluntarily respond to minor emergencies, such as small cuts, abrasions, sprains, strains, and non life-threatening emergencies. All incidents

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including those requiring outside emergency services will reported as required in Section 6 of this document.

3. TRAINING

Ramboll will utilize a recognized provider (e.g., American Red Cross or equivalent) to provide employees classified as a "Site" or "Operations" employee, a standardized training format to meet the requirement for medical and first aid response.

3.1 Training shall be provided to each affected employee:

3.1.1 Before the employee is first assigned duties that require him/her to serve as a first aid responder.

3.1.2 Before there is a change in assigned duties.

3.1.3 Whenever there is a change first aid procedure or operations.

3.1.4 Whenever Ramboll has reason to believe that there are deviations from the first aid response procedures required by this instruction or inadequacies in the employee's knowledge or use of these procedures.

3.2 The training shall establish employee proficiency in the duties required by this instruction and shall introduce new or revised procedures, as necessary, for compliance with this instruction or when future revisions occur.

3.3 The recognized medical and first aid training provider will certify that the training required by this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives. Ramboll will retain a copy of all employees that receive certification.

3.4 Levels of First Aid Training

3.4.1 Basic first aid. This basic course is available to all employees. It covers treatment of minor injuries and basic emergency procedures for more serious injuries or health problems.

3.4.2 Advanced first aid. The advanced course equips participants to handle first aid for many types of injuries and is under the direction of our local health care provider.

3.4.3 Cardiopulmonary resuscitation. Ramboll employees classified as a "Site" or "Operations" employees are required to take the CPR course.

3.4.4 Emergency medical technicians. Training for EMTs involves extensive course work off site. Ramboll employees are not EMT trained.

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4. USING EXTERNAL EMERGENCY SERVICES

All emergency information, including contact names, phone numbers, and maps, are to be kept in a written, site-specific Health and Safety Plan (HASP) and is required for all projects that involve intrusive sampling, visitation to the exclusion zones of hazardous waste sites, and/or by a client's site-specific requirements. However, for Emergency Medical Incidents, Emergency Fire Response, or Hazardous Materials Incidents, the following steps should be taken:

1. Dial 911 and/or designated site emergency number. Remember to speak SLOWLY and CLEARLY. Do NOT hang up first — let the dispatcher conclude the call.
2. Provide the following information:
   - Your exact location
   - Your name and phone number
3. Describe nature of incident:
   - Emergency Medical Incident
     - How many victims
     - Type of incident - chemical exposure, physical injury
     - Assessment of victims' condition if known (whether victim is conscious/unconscious, breathing/not breathing, pulse/no pulse, nature of injuries, first aid measures used, etc.)
     - Where incident occurred
     - Contamination status of victims - have they been decontaminated
   - Fire:
     - Location of Fire
   - Hazardous materials incident:
     - This is a hazardous materials incident requiring dispatch of HAZMAT unit
     - Type of incident (fire, explosion, spill, etc.)
     - Type of material (specific chemicals or general description)
     - Whether there is also a medical emergency (see Item 3)
4. If incident happened in an exclusion zone and/or involves chemical contamination, ask for Basic Life Support personnel to be dispatched.
5. Give location of site office.
6. An Ramboll employee must meet the emergency personnel at the staging area to brief them on the situation.
7. Do **NOT** allow volunteer personnel to enter the site.

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4.1 Directing ambulance services. Post an employee(s) at key points to direct ambulance services to the injured employee's location.

4.2 Escorting Injured Employees. In the event that an Ramboll employee is transported to a medical facility for treatment, a non-injured Ramboll employee must accompany the person being treated, if possible. This person should report back to the Project Manager (PM) and Principal in Charge (PIC) concerning the status of the employee being transported.

5. USING INTERNAL EMERGENCY SERVICES

Minor injuries, such as cuts, scratches, bruises, and burns that do not require a doctor's treatment, may be voluntarily handled by a Ramboll employee trained in rendering first aid. Alternatively, employees can visit Urgent Care facilities. If the situation escalates and additional or outside emergencies are required see Section 4.

6. REPORTING

All injuries or complaints will be reported as per SPI 19 entitled Incident Reporting At a minimum, the following information will be entered:

- Date and time of injury,
- Date and time of treatment,
- Name of injured person,
- Name of person rendering first aid,
- Nature of injury,
- Type of treatment given,
- Work or non-work related,
- First treatment or follow-up treatment,
- Task being performed,
- Description of what happened,
- What caused the incident, and
- What could have been prevented the incident.

The incident report must be signed by the affected employee and any witness. Return the completed form to your H&S.

7. FIRST AID KITS

First aid kits will be maintained in each office and on site at each project location. The type of first aid kit to be maintained will be for minor emergencies, such as cuts and skin abrasions. Where applicable, first aid supplies will be stored in a water proof container.

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Health and Safety Coordinators (HSCs) will ensure that adequate first aid supplies are maintained in each Ramboll office and are available for use. Site personnel must also bring first-aid kits to each Ramboll client or other site they visit where sampling activities will be conducted.

The minimum requirements for the containants of workplace first aid kits is outlined on page 14 of ANSI Z308.1-2003, which is included as Attachment A of this SPI.

The contents of the first aid kits shall be checked before being sent out to each job and at least weekly on each job to ensure that the expended items are replaced by the site Project Manager or designated person.

8. EYEWASHES AND DELUGE SHOWERS

Where the eyes or body of any employee may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. This will include but is not limited to, portable and fixed emergency eyewash stations and deluge showers. Where installed, these facilities will be installed in locations within the work area having ready access and periodically inspected in accordance with local requirements.

8.1 Considerations for Installation. The following criteria will be considered when making a determination for installation of eyewashes and deluge showers:

8.1.1 Employee use of personal protective equipment (PPE).

8.1.2 Type and chemical concentration of concern.

8.1.3 Special guards and/or precautions intended to provide for employee protection from exposure.

8.1.4 Based on employee job functions; determine the extent and type of probable employee exposure.

(Note: In areas where the extent of possible exposure is small, a specially designated pressure controlled and identified water hose equipped with a proper face and body wash nozzle, which will provide copious amounts of low velocity potable water, or an appropriate portable eye wash device containing not less than one gallon of potable water that is readily available and mounted for use, is considered to provide minimum employee protection when proper PPE is used.)

8.2 Personal protective equipment. PPE for eyes, face, head, and extremities, protective clothing and protective shields and barriers, shall be provided, used and maintained in a sanitary and reliable condition wherever it is necessary by reason of chemical hazards encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact.

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9. CONTINGENCY PLANNING

The nearest hospital shall be located prior contact with the hospital shall be made to ensure that they are equipped to handle chemical exposures, then the route to the hospital shall be provided on a map. Contact information, including the map and all relevant emergency telephone numbers (e.g., the telephone numbers of the physicians, hospitals or ambulances) will be included in the HASP and shall be posted in a conspicuously location while on site. In addition, this information will be included in each HASP as outlined in the HASP section of Ramboll's HazWOper Program.

10. REVISION SUMMARY

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ATTACHMENT A
MINIMUM FIRST AID SUPPLY LIST
(ANSI STANDARD Z308.1-2003)

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MINIMUM FIRST AID SUPPLY LIST

- One absorbent compress, 32 sq. inch (81.3 sq. cm) with no side smaller than 4 inches (10 cm)
- 16 adhesive bandages, 1 inch x 3 inches (2.5 cm x 7.5 cm)
- One roll of adhesive tape, 5 yards (457.2 cm) total
- 10 packets of antiseptic, 0.5 g (0.14 fl oz) applications
- 6 applications of burn treatments, 0.5 garms (0.14 fl oz)
- Two or more pairs of medical exam gloves (latex or non-latex)
- Four sterile pads, 3 inches x 3 inches (7.5 x 7.5 cm)
- One triangular bandage, 40 inches x 40 inches x 56 inches (101 cm x 101 cm x 142 cm)

Additional (but optional) items may include:

- Four 2x2 inch bandage compresses
- Two 3x3 inche bandage compresses
- One 4x4 inch bandage compress
- One eye patch
- One ounce of eye wash
- One chemical cold pack, 4x5 inches
- Two roller bandages, 2 inches wide
- One roller bandage, 3 inches wide
- CPR barrier device

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APPENDIX E

SPILL RESPONSE PROCEDURE

1. INTRODUCTION

On behalf of Pechiney Plastic Packaging, Inc. (PPPI), Ramboll has prepared this Spill Response Plan associated with the construction activities to be implemented at the Albéa Americas Inc. (Albéa) facility located at 191 Route 31 North in Washington, New Jersey ("Site"). The Albéa facility property is a 19.62-acre parcel identified as Washington Borough Block 37, Lots 1 and 2 (totaling 17.8 acres), and Washington Township Block 30, Lot 17 (1.82 acres).

Construction activities include construction/installation of a Vapor and Liquid Treatment Systems, installation of heater wells/VEWs, ISTR commissioning, startup and operation, and process system sampling and water transfer during *in-situ* thermal remediation (ISTR) operation as part of remediation of the Pohatcong Valley Groundwater Contamination Superfund Site ("PVGCS Site"). The PVGCS Site is located in Warren County, New Jersey, and is identified by the United States Environmental Protection Agency (USEPA) as ID# NJD981179047. The Albéa facility (formally called American National Can Company [ANCC]), is located near the northeastern edge of the PVGCS Site.

The purpose of this Spill Response Plan is to provide the necessary information and procedures to coordinate the handling of spills of toxic substances in the unlikely event that a significant spill or discharge should arise during implementation of the construction and operation and maintenance activities. This Spill Response Plan will also follow the Albéa Spill Prevention, Containment and Countermeasures Plan (SPCC) (BTY EHS 4.6.6-WN-DV-023) dated August 30, 2018.

1.1 Facility / Work Description

The construction work for this project includes installation of an ISTR system. Work involves ISTR heater cans with co-located vapor extraction screen installation, high-voltage power installation, and ISTR system installation.

Site operations will include extraction/treatment of vapors and condensate. Vapors will be treated using activated carbon vessels and condensate water will be treated through the GWETS. Any drilling water recovered will also be treated through the GWETS.

Liquids that could be spilled or discharged include:

- untreated condensate water;
- fuel or other fluids from construction vehicles and drill rigs; and
- decontamination water.

1.2 Inspections

Per the Albéa SPCC, aboveground storage areas (i.e., tanks, drum storage areas, containment structures, etc.) and transfer facilities will be examined whenever equipment is operated, maintained, or moved. Spill containment locations will be inspected quarterly, and spill kits will be inspected monthly.

Locations where storm water is discharged from the facility will be inspected at least annually for evidence of pollution. Routine inspections assist in the identification of leaks, spills, or the improper working order of equipment, or stormwater control problems, which may introduce pollutants to stormwater runoff. Facilities include the equipment and vehicles and their parking, storage and washing areas; storm water management devices; stormwater conveyance systems; and sediment and erosion control devices.

2. SPILL RESPONSE

Spills or uncontrolled discharge of petroleum or hazardous liquids should be handled in accordance with New Jersey Administrative Code (NJAC) 7.1E5. New Jersey spill response guidelines for petroleum and hazardous substances are attached to this plan and summarized below.

To date, the site groundwater and decontamination water has been classified as non-hazardous and therefore not subject to NJAC requirement. Also, the sequestering agent, Redux 300 is nonhazardous and is not a fire or explosion hazard and therefore not subject to these requirements.

2.1 Notification

If a spill of a hazardous liquid (included petroleum products) occurs, any person who knows or reasonably should know of the discharge must immediately notify the New Jersey Department of Environmental Protection (NJDEP) at 877-WARNDEP **(877-927-6337)**. In addition, per the Albea SPCC, the Albéa Emergency Coordinators (Russ Gladd [908-674-1479] and Felix Miranda [908-619-2159]) and the National Response Center (800-424-8802) will be notified.

In the event of a major release (spill), the Albéa Emergency Coordinators will call the Albéa local spills clean-up contractor Rineco (877-737-5277).

In the event of an emergency requiring prompt evacuation from the Albéa Washington facility (e.g., fire or explosion, the Emergency Coordinator shall initiate evacuation procedures as outlined in the Washington Facility Emergency Response Plan (BTY EHS 4.9.1-WN-DV-001).

If the release is due to a motor vehicle accident and the substance is contained on a paved roadway and the substance is removed prior to entering any waters of the State or any storm drain leading to any waters of the State, notification is not required.

Notification received more than 15 minutes after the person responsible for a discharge knew or reasonably should have known of the discharge is considered not immediate. In accordance with the Site contingency plan, the Ramboll's Construction Manager and Project Coordinator shall be notified as soon as possible at the numbers noted below.

Emergency Coordinators:

Nita Shinn, Ramboll (on site)	(cell) 904-947-0789
Adrian Ezeagu, Ramboll (on site)	(cell) 517-214-5732

or

Alyssa Larson, Ramboll (off site)	(cell) 847-732-8656
Bruce Kennington, Ramboll	(cell) 312-953-9965
	(office) 312-288-3834
If not available, contact Luis Hidalgo directly	435-932-3955

Alternate Emergency Coordinator:

Scott Tarmann, Ramboll	(cell) 262-853-9964
	(office) 262-901-0093

The emergency coordinator will implement the Contingency Plan in accordance with the site's Emergency Response Plan. The emergency coordinator will serve as chief of the emergency crew, which consists of available site staff. Ramboll has given authority to the above- mentioned emergency coordinators to expend funds and recruit trained employees in the event a spill.

2.2 Discharge Response

Any person responsible for the discharge shall:

- take immediate action to stop the discharge;
- take all necessary and appropriate measures to contain, mitigate, cleanup and remove the discharge; and
- coordinate the cleanup actions with the NJDEP.

No application of chemicals should be made without prior approval of the NJDEP or an on-scene federal agency, unless such application is necessary to prevent or mitigate a situation that poses a serious and imminent threat to human life. Unauthorized use of chemicals shall be regarded as a discharge in violation.

Minor spills may be placed in 55-gallon drums and staged on site for proper disposal.

2.3 Confirmation Report

If required by the NJDEP, a confirmation report shall be provided to the agency within 30 days of the notification. The report shall summarize the discharge quantities, mitigation measures and corrective actions taken as provided in the attached guidelines.

ATTACHMENT 1

Guidance on Discharge Notification, Discharge Response and Discharge Confirmation Reports

New Jersey Department of Environmental Protection-Bureau of Release Prevention

New Jersey Department of Environmental Protection Bureau of Release Prevention

Guidance on Discharge Notification, Discharge Response and Discharge Confirmation Reports

Effective May 12, 2005

DISCHARGE NOTIFICATION

Discharges of Hazardous Substances - Notification

The release of a hazardous substance into the waters or onto the lands of the State is defined as a discharge. Releases into waters outside the jurisdiction of the State are also considered discharges when the potential for damage to State resources exists. Exceptions are releases in compliance with Federal or State Permits.

When a discharge occurs, the Department must be notified immediately by telephone at 1-877-WARNDEP (1-877-927-6337). If this number is inoperable, notification must be made to the State Police at 609-882-2000.

Immediate notification is essential to insure an appropriate response to a discharge.[1] This is especially important if a discharge requires the attention of emergency services. Immediate notification has been defined as within 15 minutes of when a person knew or reasonably should have known that the discharge occurred. The Department may, in the absence of acceptable justification, issue a penalty for a late notification.

A notification of a discharge will include the following information:

1. Name, title, affiliation, address and phone no. of the person reporting;
2. Discharge location - a. For land - a site name, address, municipality, county; b. For waters - water body name, location relative to reference points, identification of areas the discharge may reach;
3. A common name of the substance(s) discharged;
4. Estimate of the quantity of each substance discharged;
5. Date, time the discharge began, was discovered, ended;
6. Action taken or to be taken to contain, clean up, remove;
7. Name, address of the responsible person.

The above list must be conspicuously posted at any transfer area and operation center of any facility that performs marine transfers, and on the bridge or pilot house of any vessel which is ordinarily docked.

Malfunctions of Discharge Detector Systems - Notification

Discharge monitoring devices are any equipment or instrumentation used to detect discharges at a facility. In the event of a failure of such a device or system, the Department must be notified immediately. Notification is made to the Department at 1-877-WARNDEP (1-877-927-6337). If this number is inoperable, notification must be made to the State Police at 609- 882-2000.

Within two hours of the initial notification, the facility must notify the Department that one of the following situations exists:

1. The malfunction has been repaired;
2. An alternate or replacement system has been activated;
3. The equipment monitored by the faulty system has been taken out of service.

[1] The Bureau of Communications and Support Services at 1-877-WARNDEP (1-877-927-6337) is a 24-hour service capable of notifying emergency services. The State Police have a similar capability.

Guidance for Notifications

When possible, train individuals for different roles in responding to a discharge. Select one individual with the primary responsibility of controlling the discharge. Select another individual who can determine if notification is required and who is responsible for obtaining and transmitting the required information. Devise a system for quickly gathering and relaying the needed information. A form prepared ahead of time can contain much of the needed information (addresses, names, and such), and save valuable time needed for immediate reporting.

Exceptions from Discharge Notification Requirements

A discharge does not have to be reported to the Department if it does not have to be reported under any other state or federal law and meets all of the following requirements:

1. The facility where the discharge occurs has an approved plan[2] and;
2. The discharge has not entered any waters of the State or migrated off- site;
3. The discharge has been stopped, contained, cleaned up, and removed within 24 hours;
4. The response to the discharge is documented in accordance with N.J.A.C. 7:26E3[3];
5. Records are available for review for three years from the date of the discharge.

A discharge of **transformer fluid** does not have to be reported if the fluid contains less than 500 parts per million of polychlorinated biphenyls, and it meets the following requirements:

1. The discharge occurs during a state of emergency declared by the federal, State or local government; and
2. The discharge is reported to the Department within 24 hours of termination of the state of emergency; or else
3. The discharge is less than 25 gallons;
4. The discharge has not entered any waters of the State or migrated off- site;
5. The discharge has been stopped, contained, cleaned up, and removed;
6. The response to the discharge is documented in accordance with N.J.A.C. 7:26E4[4]; and
7. Records are available for review for three years from the date of the discharge.

[2] The facility has an approved DPCC and DCR plan pursuant to N.J.A.C. 7:1E-4.6, or a Risk Management Plan pursuant to N.J.A.C. 7:31, or an Emergency Response Plan pursuant to N.J.A.C. 7:26-12, or a Response Plan pursuant to 40 CFR 112.

[3] Technical Standards for Site Remediation

[4] Technical Standards for Site Remediation

DISCHARGE RESPONSE

Guidance for Discharge Response

With consideration for personal safety foremost, the immediate response to a discharge is to stop the source of the discharge. To expedite this action, key valves, pumps, and shut-off devices should be prominently labeled, and their location and operation should be reviewed with employees during periodic emergency response exercises and drills. When possible, these devices should be located in areas that would not be in the direct path of a potential discharge. Once a discharge has been stopped, appropriate actions should be initiated to contain the spilled material and then to remove, containerize and dispose of it.

In addition to training personnel in the conduct of actions required to respond to a discharge, every facility must make arrangements to coordinate such actions with the appropriate authorities, including the Department. An individual or individuals should be trained to handle notification and coordination with local emergency services and the Department.

Except for situations where there is an imminent threat to life, chemicals or dispersants should not be applied to a discharge without prior approval of the Department or a federal on-scene coordinator. In the event a serious threat to life exists, a reasonable effort to obtain approval should be made before applying chemicals. Chemicals or dispersants may be applied to a discharge when their application has received prior approval in a DCR plan.

In instances where the Department determines that cleanup activities are not being conducted in a proper and expeditious manner, the Department may act to remedy the discharge.

DISCHARGE CONFIRMATION REPORTS

Guidance for Preparation of a Discharge Confirmation Report

A telephone notification of a discharge at a major facility must be followed up with a written report documenting the event. This report must be submitted to the Department within 30 days of the initial notification.

The written report must include the following information:

1. Name, address and phone no. of the person who reported the discharge;
2. Name, address and phone no. of the person submitting the report (only if different from (1);
3. Name, address and phone no. of each owner and operator of the facility, vessel or vehicle involved in the discharge;
4. The source of the discharge;
5. Discharge location a. For land - a site name, address, tax lot and block, municipality, county, State plane coordinates; b. For waters - water body name, State plane coordinates; c. For off-site areas - a map of the affected area;
6. Common names and CAS number of each substance(s) discharged;
7. Estimate of the quantity of each substance discharged;
8. Dates, times the discharge began, was discovered, ended, and the Department was notified;
9. Measures taken to contain, clean up, remove, and a summary of costs;
10. Corrective or preventative measures taken or proposed to minimize possible recurrences;
11. Name, address and phone no. of all entities involved in containment, clean up or removal;
12. A description of any samples taken;
13. Certification stating that financial responsibility is in full effect;
14. Certification by highest ranking individual as to accuracy of report;
15. For late notification, refer to N.J.A.C. 7:1E-5.6 “Justification of delay”.

Confirmation reports for discharges at a major facility or transmission pipeline should be submitted to:

Bureau of Release Prevention
NJDEP
22 S. Clinton Avenue - 3rd floor
P. O. Box 424
Trenton, New Jersey 08625-0424
Attention: Discharge Confirmation Report

APPENDIX F

SITE MAPS

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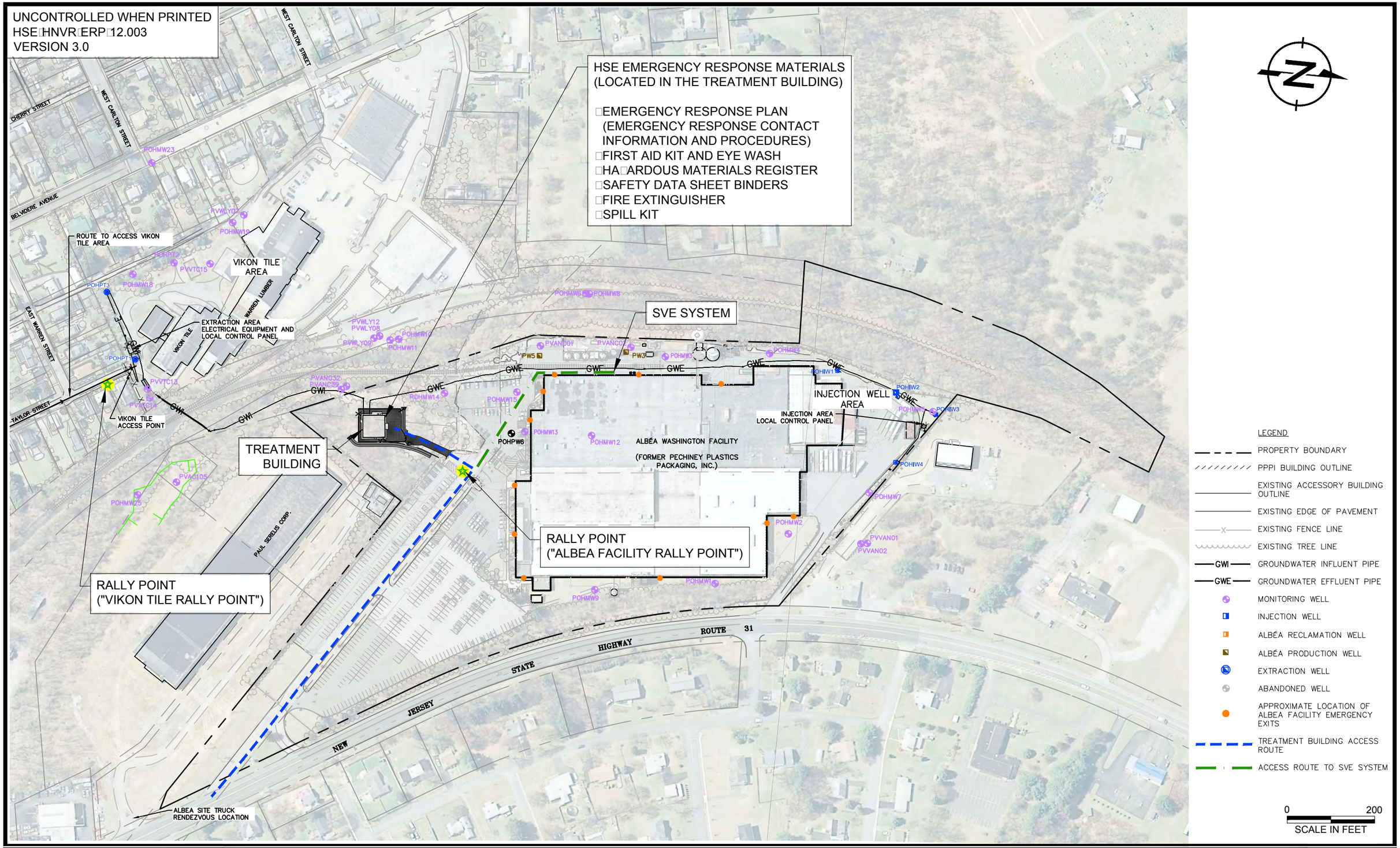
HSE HNVR ERP 12.003
VERSION 3.0



RAMBOLL ENVIRON

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LOCATION OF RALLY POINTS AND EMERGENCY RESPONSE MATERIALS - OM&M PHASE

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE
OU1 TCE GROUNDWATER
WARREN COUNTY, NEW JERSEY

FIGURE
G-1

PROJECT: 213 1A

BCARRIERE /25/1 F: 213 1 POHATCONG OMM SP RALLY POINTS AND EMERGENCY RESPONSE 213 1 /25/1

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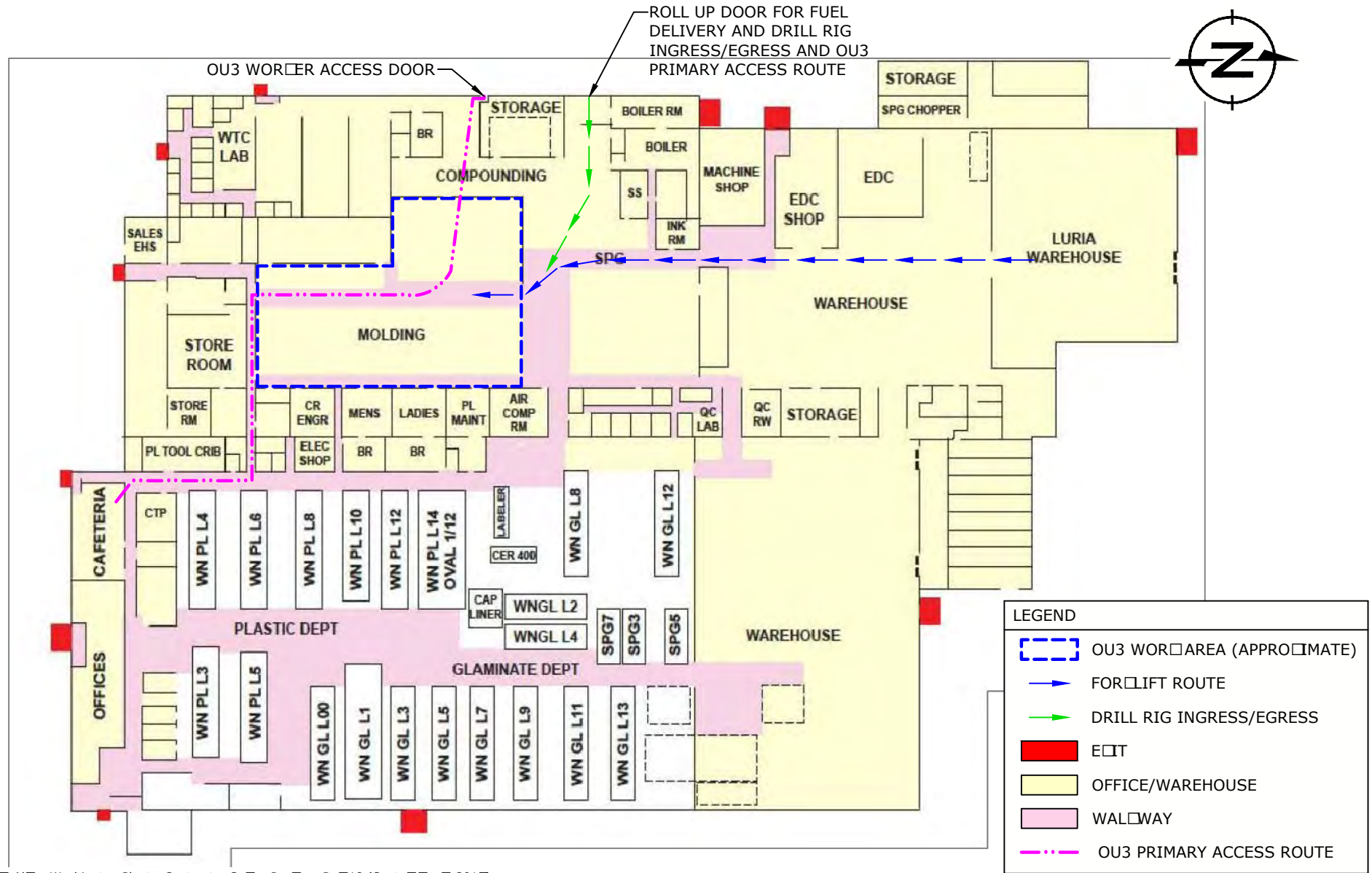


Site □ap fo□ Al□ea Washington Plant - Contractor Sa□ety Pac□age Re□18 (Septe□□er □ 201□).

RAMBOLL

INTERIOR ACCESS ROUTE □OU□WOR□ AREA

POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE (ALBEA FACILITY)
WARREN COUNTY, NEW JERSEY

FIGURE □

DRAFTED BY: ELS/C□L | DATE: 2/26/18 | 169000□063

APPENDIX G

EMERGENCY INFORMATION

TABLE 1A: EMERGENCY RESPONSE TELEPHONE ROSTER

	Office	Cell
CLIENT CONTACT		
Luis Hidalgo, Rio Tinto HSE		435-932-3955
Brad Gibson, Rio Tinto HSE		801-557-8236
RAMBOLL PERSONNEL		
Principal In Charge: Mark Travers	312-288-3890	312-375-8080
Project Manager/Project Director: Bruce Kennington	312-288-3834	312-953-9965
HSEQ MS Coordinator: Alyssa Larson	303-382-5463	847-732-8656
Project Engineer: Scott Tarmann	262-901-0093	262-853-9964
Project Manager: Stan Popelar	312-288-3858	815-793-6442
Designated Site Safety Officer: Adrian Ezeagu	609-243-9849	517-214-5732
Designated Site Safety Officer: Nita Shinn	813-397-4730	904-947-0789
Designated Site Supervisor: Michael Eddings	913-553-5929	785-250-3648
Designated Site Supervisor: Doug Burge	314-590-2963	314-378-8065
Health & Safety Coordinator: Jeff Parsons	315-956-6813	
Global Director, Health and Safety: Jim Fox		315-391-0638
TRS Group, Inc. – PRIMARY OU3 ISTR Contractor		
Senior Project Manager: Christopher Thomas	847-376-3691	360-560-4845
HSE Representative: TBD		
GWTT – Existing Systems OMM Contractor		
Project Manager: Pat Biskey	973-983-0901	973-224-4120
HSE Representative: Tiffany Brown		201-317-2063
Site Safety Officers: Mark Turner Teague Alessi		 973-487-6326 973-879-2460
Treatment System Operators: Mark Turner		973-487-6326
ALBÉA FACILITY/SECURITY		
EHS Leader: Felix Miranda		908-619-2159
Albéa contact for OU3: Russell Gladd	908-835-5231	908-674-1479

EMERGENCY RESPONSE AGENCIES		
Hospital: St. Luke's Warren Hospital	911	
Emergency Fire	911	
Emergency Police	911	
Warren County Health Department	908-475-7960	
Ambulance Service: Washington Emergency Squad	908-689-0909	
Washington Township Emergency Management: Frank Campbell		609-685-1545

OTHER EMERGENCY ASSISTANCE		
CHEMTREC	800-424-9300	
National Response Center (oil and chemical spills)	800-424-8802	
Poison Control Center	800-222-1222	
Federal Emergency Management Agency	202-646-2500	
State Agency: NJ Department of Environmental Protection Hotline	877-927-6337	

OFF-SITE AGENCIES – NON-EMERGENCY PHONE NUMBERS		
Police: Washington Township Police Department	908-689-1630	
Hospital: St. Luke's Warren Hospital	908-859-6700	
Medical Clinic: Medical Care Associates	908-574-5731	
Fire: Washington Fire Department	908-689-3836	
Ambulance Service: Washington Emergency Squad	908-689-0909	
Federal Agency: US Environmental Protection Agency: Region 2	212-637-4232	
State Agency: New Jersey Department of Environmental Protection	866-337-5669	
Washington Township Emergency Management: Frank Campbell	856-589-0523	
General	856-589-6650	

	Emergency	**Non-Emergency**
UTILITIES – EMERGENCY & NON-EMERGENCY PHONE NUMBERS		
Electric: New Jersey Power and Light	888-544-4877	800-662-3115
National Gas: Elizabethtown Gas	800-492-4009	800-242-5830
Vince Holmes, Elizabethtown Gas Representative	908-413-6856	908-413-6856
Water: New Jersey American Water	800-987-5325	800-652-6987
Sewer: Washington Borough Sewer Department	908-835-2000	908-689-0623
Internet/Telephone/Cable: Verizon - Tony Rogers, Local Manager		973-902-3625
Comcast		908-689-3355

TABLE 1B: EMERGENCY SERVICES INSTRUCTIONS

For Emergency Medical Incidents, Emergency Fire Response, or Hazardous Materials Incidents

Emergency Telephone Numbers:

- Hospital: 911
- Police: 911
- Fire Department: 911

1. **Remember to speak SLOWLY and CLEARLY. Do NOT hang up first: let the dispatcher conclude the call.**

2. Provide the following information:

   A Location: 191 Rte 31 North, Washington, NJ 07882

   B. Your name and phone number

3. Describe nature of Incident:

   A. Emergency Medical Incident
   - How many victims
   - Type of incident - physical injury, etc.
   - Assessment of victims' condition if known (whether victim is conscious/unconscious, breathing/not breathing, pulse/no pulse, nature of injuries, first aid measures used, etc.)
   - Where incident occurred

   B. Fire:
   - Location of Fire

   C. Hazardous Materials Incident:
   - This is a hazardous materials incident requiring dispatch of HAZMAT unit
   - Type of incident (fire, explosion, spill, etc.)
   - Type of material (specific chemicals or general description)
   - Whether there is also a Medical Emergency

4. Give your location at the Site

Note: Security, Site Supervisor or designee must meet the emergency personnel at the staging area to brief them on the situation.

ROUTE DESCRIPTION AND MAP TO HOSPITAL FROM ALBÉA PROPERTY

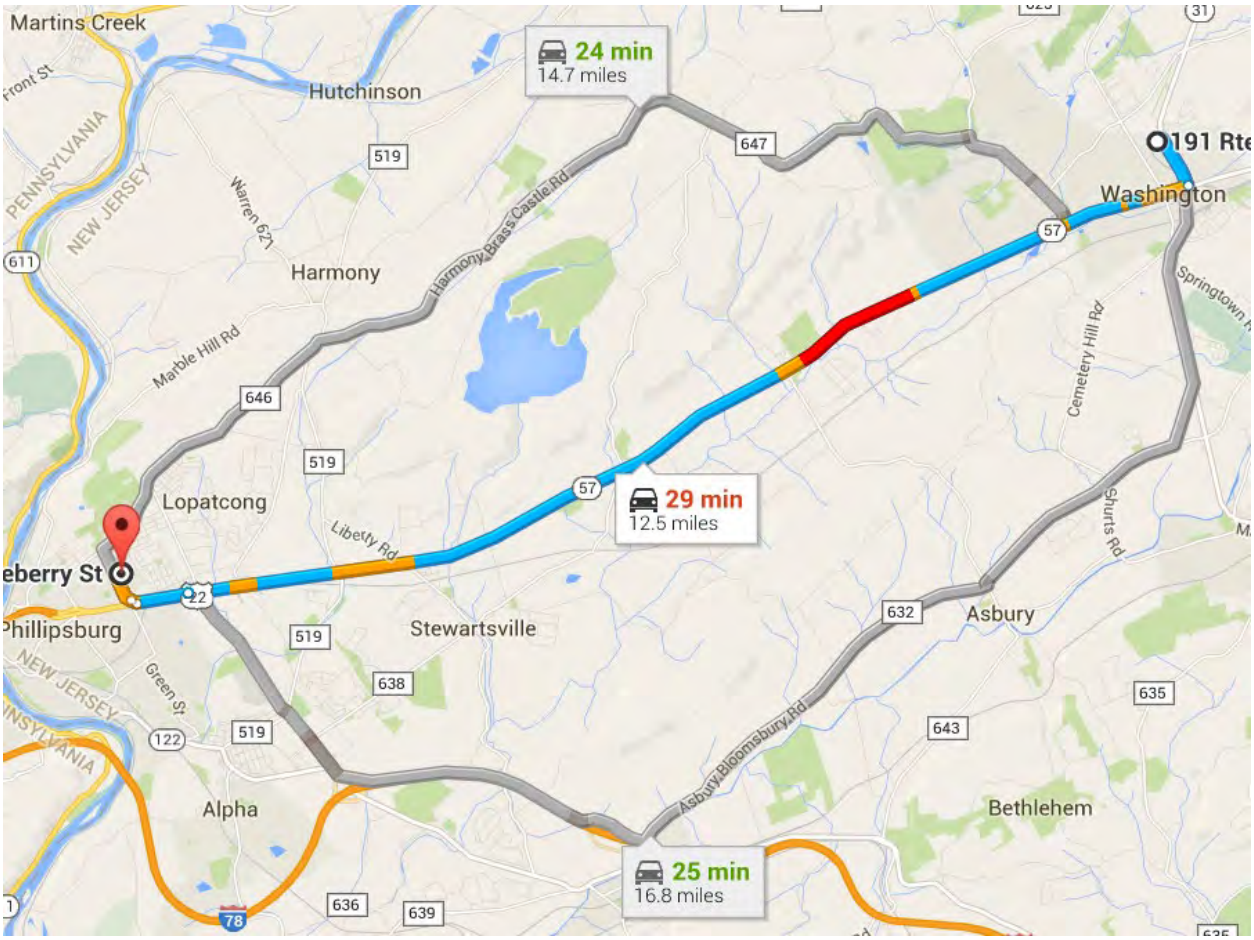
Hospital Information:

Hospital Name: St. Luke's Warren Hospital
Hospital Address: 185 Roseberry St., Phillipsburg, NJ 08865
Hospital Phone Number: 908-859-6700

Directions to Area Hospital:

- Head **south** on Rte 31 toward Myrtle
- Turn right onto NJ-57W/E Washington Ave
- Continue onto US-22W
- Slight right toward Roseberry St
- Slight right onto Roseberry St
- St. Luke's will be on the right

End: 185 Roseberry St, Phillipsburg, NJ (Destination will be on the right)



Health and Safety Plan
In Situ Thermal Remediation

Operable Unit 3, Pohatcong Valley Groundwater Contamination Superfund Site
Warren County, New Jersey

Issued: October 2019

Title	Signature	Date
Greg Knight TRS Group, Inc. TRS Safety & Quality Manager		
Christopher Thomas TRS Group, Inc. Senior Project Manager		

TRS
TRS Group, Inc.
Accelerating Value

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Abbreviations and Acronyms

AED	automatic electronic defibrillator
AHA	activity hazard analysis
ANSI	American National Standards Institute
APF	assigned protection factor
APR	air purifying respirator
ASTM	American Society for Testing and Materials
BBS	Behavior Based Safety
CF	correction factor
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
COC	contaminant of concern
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
CSP	Corporate Safety Program
CVOC	chlorinated volatile organic compound
^oC	degrees Celsius
dB	decibel
DOT	(United States) Department of Transportation
ERP	Emergency Response Plan
E-Stop	emergency stop
eV	electron volt
EZ	exclusion zone
ft^2	square feet
ft bgs	feet below ground surface
ft/day	feet per day
^oF	degrees Fahrenheit
GAC	granular activated carbon
GFCI	ground fault circuit interrupter
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations
HEPA	high efficiency particulate air
Hi-Vis	high visibility
HVAC	heating, venting, and air conditioning
IDLH	immediately dangerous to life and health
IE	ionization energy
ISTR	*in situ* thermal remediation
kV	kilo Volt

lb	pound (US weight measure)
LGAC	liquid-phase granular activated carbon
LOTO	Lockout/Tagout
mg/kg	milligrams per kilogram
mg/m^3	milligrams per cubic meter
mph	miles per hour
N/A	not applicable
NAPL	non-aqueous phase liquid
NFPA	National Fire Protection Association
NR	not reported
OEL	occupational exposure limit
OSHA	(United States) Occupational Safety and Health Administration
OU	Operable Unit
OV	organic vapor
PEL	permissible exposure limit
PID	photoionization detector
PM	Project Manager
ppm	parts per million
PPE	personal protection equipment
PVC	polyvinyl chloride
PVGCS Site	Pohatcong Valley Groundwater Contamination Superfund Site
Ramboll	Ramboll US Corporation
RZ	restricted zone
SBO	safe behavior observation
SDS	safety data sheet
SHSO	Site Health and Safety Officer
SOP	standard operating procedure
SPM	Senior Project Manager
SQM	Safety & Quality Manager
SZ	support zone
TCE	trichloroethene
TCH	thermal conduction heating
TIG	tungsten inert gas
TMP	temperature monitoring point
TRS	TRS Group, Inc.
TWA	time weighted average
UV	ultraviolet
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compounds

VP	Vice President
VR	vapor recovery
yd^3	cubic yards

HEALTH AND SAFETY PLAN SUMMARY

Project Information:

Client: Ramboll US Corporation

Client Address: 333. W.Wacker Drive, Suite 2700, Chicago, Illinois

Project Location: Washington, New Jersey

Project Objectives: In Situ Thermal Remediation (ISTR) via thermal conduction heating (TCH) of trichloroethene (TCE) and TCE breakdown products in soil. The primary contaminant of concern (COC) is TCE. The primary remediation goal for the project will be the reduction of TCE 1 milligram per kilogram (mg/kg) in soil and achieving 90 degrees Celsius (°C) at 95 percent of the temperature monitoring points (TMPs).

The TCH treatment area is approximately 39,000 square feet (ft^2) and extending from as shallow as 65 feet below ground surface (ft bgs) to as deep as 120 ft bgs, dependent on the targeted heating zone. The TCH treatment volume is approximately 28,000 cubic yards (yd^3). The ISTR project will employ a total of 178 TCH heater wells to complete the remediation (see **Figure 3** for TCH remediation area details).

Health and Safety Plan Preparation:

Prepared by: Greg Knight, TRS Safety & Quality Manager (SQM)

Reviewer/Approver: Chris Thomas, TRS Senior Project Manager (SPM)

Project Personnel:

Ramboll Primary Contact: Nita Shinn	**Phone:** (904) 947-0789
TRS Senior Project Manager: Chris Thomas	**Phone:** (360) 560-0243
TRS Project Manager: Sean Fournier	**Phone:** (978) 502-6525
TRS Site Health & Safety Officer: Jeff Riffe	**Phone:** (765) 562-2252

Nearest Local Hospital:

St. Luke's Warren Hospital
185 Roseberry Street
Phillipsburg, New Jersey 08865
908-859-6700
Hours: Emergency care available 24 hours, seven days a week

Distance: 12.5 miles, Drive Time: Approximately 12 minutes

Directions from Site (See **Figure 1**):

1. Head south on Route 31 South toward Myrtle – 0.5 miles
2. Turn **RIGHT** onto NJ-57 W/E Washington Avenue
3. Continue on NJ-57 W/E to US-22 – 11.0 miles
4. Slight **RIGHT** onto US-22 W – 0.5 miles
5. Turn **RIGHT** onto Roseberry Street – 0.3 miles
6. Turn **RIGHT**, St. Luke's is on the right. – 377 feet

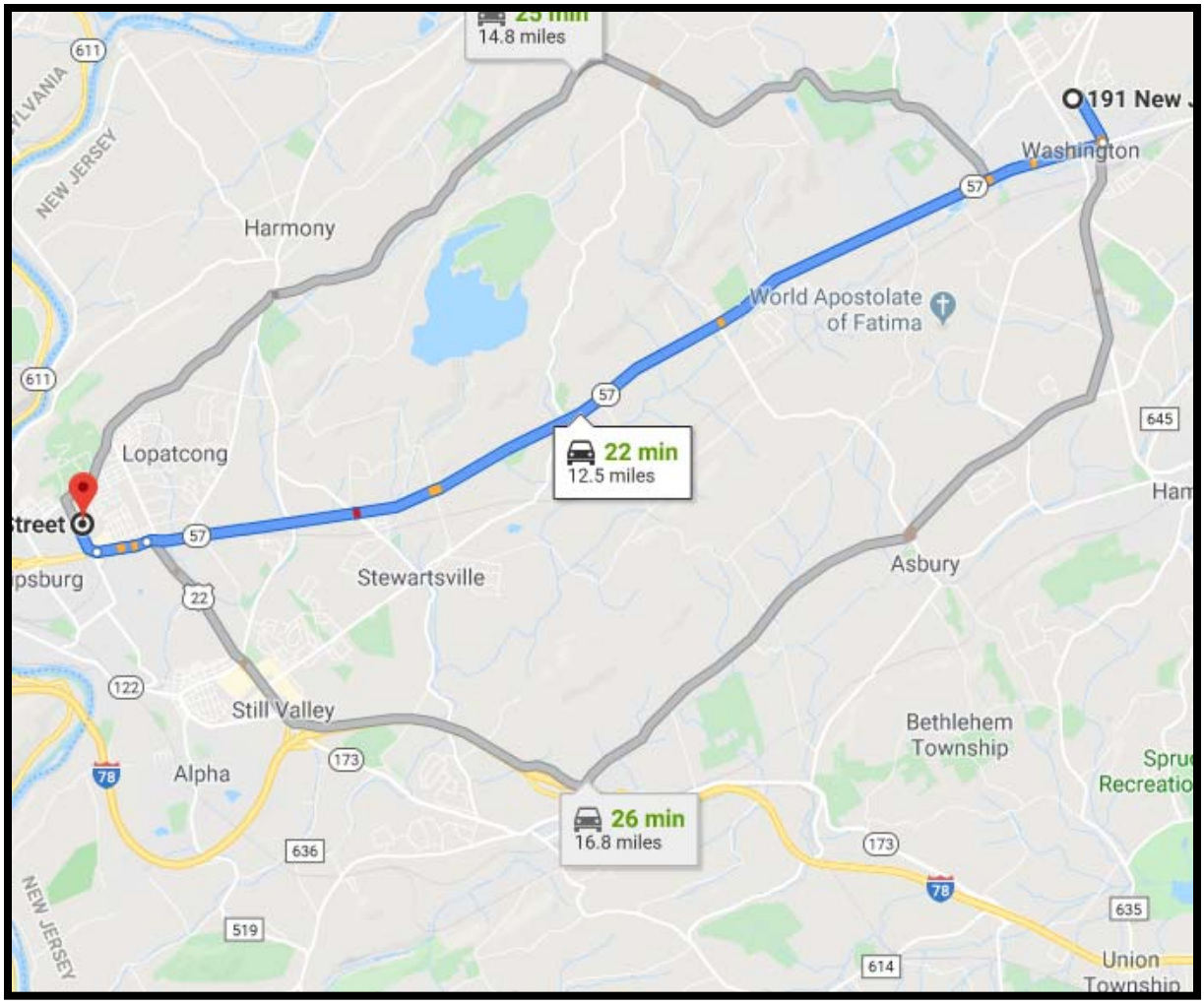

Figure 1. Directions to St. Luke's Warren Hospital – Phillipsburg, NJ

Nearest Occupational Medical Center

St. Luke's Occupational Medicine - Belvidere
187 County Route 519
Belvidere, NJ 07823
(856) 780-9910

Hours: 8:00 AM to 6:00 PM, Monday through Friday

Distance: 8.4 miles, Drive Time: Approximately 13 minutes

Directions from Site (See **Figure 2**):

1. Head north on NJ-31 N toward Essex Road – 3.4 miles
2. Turn **LEFT** after Fulton Bank (on the left) – 469 feet
3. Continue onto Belvidere Avenue – 0.5 miles
4. Continue onto County Road 624 – 177 feet
5. Continue onto Belvidere Avenue – 1.1 miles
6. Continue onto Hazen Oxford Road – 1.1 miles
7. Turn **RIGHT** onto Brass Castle Road – 0.4 miles
8. Turn **LEFT** onto County Road 519 – 1.7 miles
9. Turn **LEFT** onto Belvidere Avenue, destination will be on the right – 482 feet

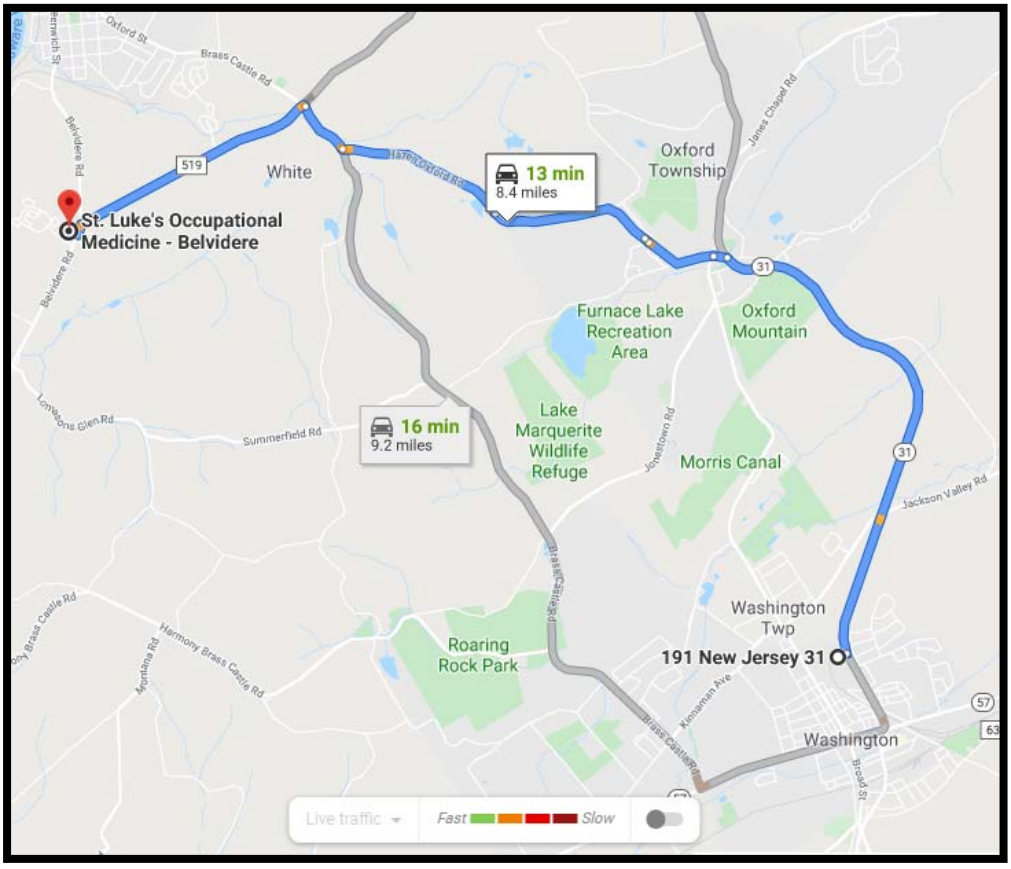

Figure 2. Directions to St. Luke's Occupational Medicine – Belvidere, NJ

EMERGENCY PHONE NUMBERS

Paramedic: 9-1-1 **Fire Dept.:** 9-1-1 **Police Dept.:** 9-1-1

Emergency/Contingency Plans: Call 9-1-1 and then administer first aid if it is safe to do so and responders are properly trained and certified in first aid and cardiopulmonary resuscitation (CPR).

Site Control Measures: Only authorized personnel are permitted inside established exclusion zones (EZs), contaminant reduction zones (CRZs) and support zones (SZs). During operations, only authorized personnel are permitted in the TCH restricted zone and only qualified persons are allowed within the TCH EZ as defined by TRS access requirements.

15 Minute Eyewash: Required during use of corrosive materials (i.e., vapor recovery pipe assembly), otherwise optional

Eye Wash Bottles: Required (minimum of six 32-ounce bottles)

Fire Extinguishers: Required (see **Section 13.0** for details) – one A-B-C per 3,000 ft^2

First Aid Kit: Required (see **Section 13.0** for details)

Blood borne Pathogen Kit: Required

Emergency Shower: Not Required

Personal Decontamination Procedures: Thoroughly wash hands before eating. Use proper level of personal protective equipment (PPE) as noted in this HASP. **The minimum PPE level for the project is Level D.**

Table 1. Hazard Inventory

Summary of Chemical Hazards	
Primary Expected Compounds:	Soil: Volatile organic compound (VOC) contaminants with primarily trichloroethene (TCE) as the contaminant of concern (COC).
Source	TCE contamination at the OU3 is associated with former activities at the property.
Pathways	Inhalation, skin absorption, ingestion, skin and/or eye contact
Concentrations	The maximum TCE concentrations detected in soil within the ISTR treatment volume is 40 milligrams per kilogram (mg/kg).
Health Hazards (TCE)	**Signs & Symptoms:** Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen] **Target Organs:** Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system

Summary of Physical Hazards					
Y	Heat	Y	Slip, Trip, Falls	Y	Shallow Excavations/Trenching
P	Cold	Y	Electrical Hazards	Y	Moving Equipment
P	Wet	P	Underground Hazards (utilities)	N	Confined Space
Y	Noise	Y	Overhead Hazards (utilities, hoisting)	Y	Hydraulic Equipment
Y	Lifting	P	Acids and Bases	Y	Rotating Equipment
P	Steam	Y	Sharp and/or abrasive items	Y	Hand Held Power Tools

Notes: Y = Yes, N = No, P = Possible, A = As Needed, R = Required, N = Not Required, HEPA = High Efficiency Particulate Air, PVC = Polyvinyl Chloride

Table 1. Hazard Inventory (continued)

Summary PPE Requirements (See Section 4.0 for details regarding PPE requirements)					
R	Hard Hat – Required at all times	R	Safety Eye gear	Glasses meeting ANSI Z87.1-2010 standards	
R	Safety Boots or shoes	A	Respirator (w/ P100 OV cartridges)	Half Face (A)	Full Face (A)
R	High-Visibility vest or equivalent (ANSI Type 2) – Required during using of all heavy equipment including forklifts and man-lifts	A	Filter Type	Organic Vapor (A)	HEPA (A) (P100 particulate filter)
R	Hearing Protection – Install	R	Gloves	Work (R)	Nitrile (A)
A	Hearing Protection – Ops	A			
A	Tyvek Coveralls	A	Gloves	Neoprene (A)	PVC (A)
N	5-Min. Escape Respirator	A	Gloves	Cut Resistant (A)	

Summary of H&S Monitoring Equipment Requirements		
Organic Vapor	Photoionization detector (PID) with 10.6 electron volt (eV) lamp	R
Organic Vapor	Analyzer (flame ionization detector; FID)	N
Oxygen Meter	Exclusion Zone Air Monitoring	A
Combustible Gas Meter	Exclusion Zone Air Monitoring	A
Passive Dosimeter		N
Hydrogen Sulfide (H2S) Meter		N
Dust Meter	Breathing Zone Air Monitoring (intrusive activities)	A
Other Meters	4-Gas Multi-Meter (oxygen, carbon monoxide, carbon dioxide, hydrogen sulfide)	A

Notes: Y = Yes, N = No, P = Possible, A = As Needed, R = Required, N = Not Required, HEPA = High Efficiency Particulate Air, PVC = Polyvinyl Chloride

1.0 INTRODUCTION

TRS Group, Inc. (TRS) is the selected contractor for the *in situ* thermal remediation (ISTR) of trichloroethene (TCE) within the designated treatment volume at the Albéa property located at 191 Route 31 North, Warren County, New Jersey. TRS will apply thermal conduction heating (TCH) technology to remediate TCE in soil within the TCH treatment volume. The TCH treatment area is approximately 39,000 square feet (ft^2) in area. The TCH treatment volume is comprised of several different heating zones. Depth of treatment begins as shallow as 65 feet below ground surface (ft bgs) and extends up to 120 ft bgs, dependent on the heating zone. The corresponding TCH treatment volume is about 28,000 cubic yards (yd^3). See **Figure 3** for details of the TCH treatment area and surrounding features.

TRS has entered into this work under contract with Ramboll US Corporation (Ramboll).

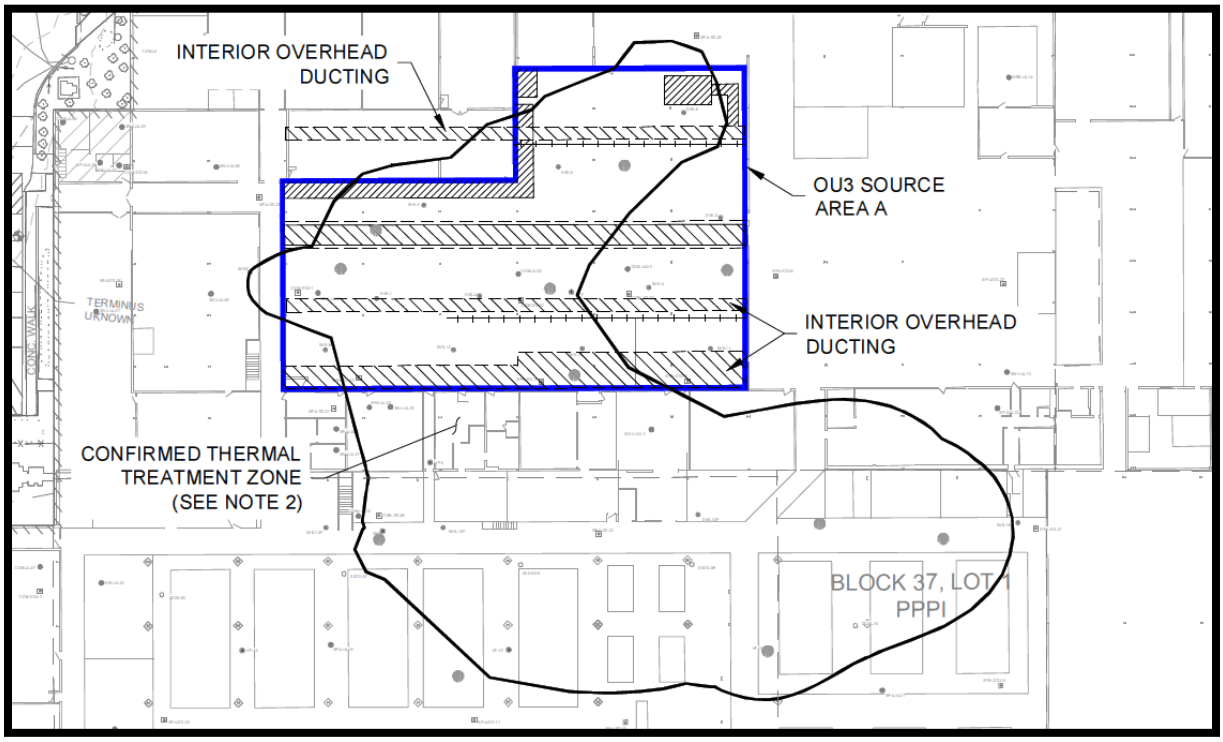

Figure 3. Thermal Conduction Heating Site Plan

The TRS Corporate Safety Program (CSP) describes policies and procedures to be followed to create a safe and healthy work environment. The CSP is supported by this Health and Safety Plan (HASP) which is a site-specific document that describes the process for identifying the physical and health hazards that could harm workers, procedures to prevent accidents, and steps to take when incidents occur.

Work covered by this HASP includes all tasks related to the installation, operation, and demobilization of a TCH remedial system at the referenced property. Work to be performed under the scope of this HASP includes: installation of TCH heaters, heater wells, and temperature monitoring points (TMPs), assembly of vapor recovery (VR) system piping, placement and installation of remediation system components, operation of the TCH remediation system, and

deconstruction/demobilization of the TCH system and its related equipment. TRS and Ramboll will also perform work place health and safety monitoring as needed during the project.

If significant changes occur in project activities associated with the ISTR work, the HASP will be modified to reflect changes. All staff associated with the remediation project and facility operations will be notified following changes to the HASP. On-site workers, including subcontractors and project visitors, will comply with this HASP and any revisions made to the plan. A copy of the HASP will be maintained by the Site Health and Safety Officer (SHSO) and kept readily available for reference by all project workers.

TRS recognizes that potential hazards are inherent with ISTR related work. TRS expects that all work related to the application of TCH will be conducted in a safe and healthful manner by all staff on-site. All project participants are responsible for conducting work in accordance with applicable federal, state, and local regulations. In addition, all work performed will be completed in accordance with the CSP, applicable TRS Standard Operating Procedures (SOP) and TRS Best Practices. Where there is concern that implementation of work could compromise the safety or health of an individual, personnel noting such conditions are obligated to stop work and immediately notify the on-site TRS Project Manager (PM) or SHSO. All TRS project personnel, TRS subcontractors, and Ramboll personnel are authorized to immediately stop work for any ISTR related task or operation that poses unreasonable risk to human health, the environment, or property.

Table 2. Summary of Project Information

Project Name	Operable Unit 3 – Pohatcong Valley Groundwater Contamination Superfund Site
TRS Project Number	NJ.POH.0778
Project Description	ISTR will be conducted to reduce the concentrations of TCE in soil in the treatment volume. ISTR treatment depth ranges from 65 ft bgs to 120 ft bgs. The total volume of the ISTR treatment area is approximately 28,000 yd^3. The ISTR design consists of 178 TCH heater wells.
Current Status of Project Site	The project site is an active facility. The room in the facility where the installation occurs will not be occupied during installation, remediation, and decommissioning of the TCH system.
Suspected Chemical Hazards	The primary contaminant of concern (COC) is TCE detected in soil.
Known Physical Hazards	ISTR Zone Hazards: Electricity, steam, contact with COCs and other Site contaminants, vehicles, heavy machinery, hydraulic systems, hoisting/rigging, rotating engines, pressurized lines, power tools, pinch-points, chemicals, extreme weather, lifting, working at height, slip/trip/fall, and physical stress/fatigue

Field Activities	ISTR Zone preparation and equipment mobilization, subsurface heater and temperature monitoring point (TMP) installations (drilling oversight), VR piping installation, TCH facility construction, TCH system operations, process monitoring and sampling, equipment deconstruction/demobilization, and waste management/disposal.

2.0 SITE INFORMATION AND HAZARDS

The Site is referred to as the Pohatcong Valley Groundwater Contamination Superfund Site (PVGCS Site) and encompasses an area of approximately 16.5 square miles. The PVGCS Site is divided into three (3) Operable Units (OUs). OU3 is defined by the United States Environmental Protection Agency (USEPA) as the source area and where TRS will apply TCH to remediate TCE and other VOCs. The TCH treatment volume is located on the Albéa property located at 191 Route 31 in Washington, New Jersey. The Albéa facility on the property is a 300,000 ft^2 building, which includes, production areas, warehouse space, maintenance areas, mechanical rooms, raw material storage areas, waste management storage areas, and office space.

Based on the data provided by Ramboll, the treatment area for the application of TCH is approximately 39,000 ft^2 with treatment depth varying between 65 ft bgs to 120 ft bgs. The total targeted volume of soils within the treatment areas is approximately 28,000 yd^3.

Previous studies conducted by others in OU3 indicate that the TCE contamination is associated with the former activities at the facility in OU3. The details regarding known COCs are presented in **Table 4**.

2.1. Scope of Work

TCH is an *in situ* process whereby soils and groundwater are heated by placing an electrically operated heater into a heater well (casing) installed into the subsurface volume to be remediated. During TCH, the subsurface is heated to the necessary temperature to volatize volatile organic compounds (VOCs) to convert to vapors. Any steam produced from this process acts as a carrier gas to sweep the contaminant vapors to recovery wells where they are subsequently removed from the subsurface for surface treatment.

The primary remediation objectives for this project are to:

- Reduce concentrations of TCE in soil at compliance points to 1 milligram per kilogram (mg/kg) or less
- Achieve 90 degrees Celsius (°C) or higher in 95 percent of TMP locations

Before work begins at the Albéa facility, TRS evaluated and identified potential hazards during all phases of work on-site and developed this HASP to establish specific control measures to mitigate TCH work area hazards. Hazards resulting from construction, system operations, and demobilization activities are controlled using one or more of the control measures listed below:

- Eliminate the hazard
- Mitigate the hazard through engineering/design

- Guard the hazard
- Utilize warning or alarm device to control the hazard
- Obtain specialized training and follow specific procedures
- Establish exclusion zones (EZs) to isolate hazards
- Minimize risk associated with the hazard through the use of personal protective equipment (PPE)

2.2. Subsurface and Overhead Utility Hazards

The TCH remediation area is within the Albéa facility. There are overhead restrictions to be aware of during installation of the TCH system.

The following overhead utilities or structures exist in the portion of the Albéa facility where drilling activities will take place. Those overhead restrictions/obstructions are:

- Heating, ventilation, and air conditioning (HVAC) ducts
- Fire suppression network
- Overhead crane track (I-beams)
- Lighting fixtures
- Electrical conduits
- Electrical control boxes
- Fluid conveyance piping
- Cable trays
- Other unspecified piping/conduits

Prior to beginning intrusive work, TRS will request a public utility locate via the local one-call service. In addition, a private utility locator will be contracted to survey the TCH treatment area and surrounding features for private utilities.

Note: *Extreme caution should be exercised while performing intrusive activities (drilling, trenching, and excavation) in areas of known or suspected subsurface utilities. Site-specific work plans that identify utility-related hazards and hazard mitigation should be developed and reviewed prior to these activities. Special attention to "day-light" utilities should be considered for drilling activities associated with heater wells and temperature monitoring points (TMPs) in the vicinity of subsurface utilities.*

Based on the type and size of features present, the TRS PM and Project Engineer will determine the need for any changes to the proposed locations of the subsurface TCH components to ensure safe construction and maintain appropriate operational distances. In the case that drilling, or excavation is planned for any location less than five-feet from any marked active utility, the location will be cleared using hand-tools or similar non-destructive equipment (air knife, vacuum-excavation, or equivalent) to a depth of at least 5 ft bgs. Whenever possible, subsurface utilities within five feet of drilling or excavation locations should be excavated by non-destructive means to expose the physical utility (day-lighted) to confirm the actual location, depth, and linear run of that utility.

In general, buried electric power lines, communications lines, and other utility services could exist within a few feet below ground surface. Digging into an underground electric line can cause power outages and personal injury from shock or electrocution. These underground facilities are not always located out in public areas. A subsurface utility survey and locations of subsurface utilities will be verified by a TRS-hired professional locating company prior to any intrusive activities. It is important to identify all buried utilities in and adjacent to the TCH treatment area so that proper measures can be designed into the system to mitigate the potential for preferential pathways of subsurface vapors during TCH application and/or damage to existing subsurface structures.

2.3. Subsurface Installation Hazards

All TCH heater wells will be installed within the Albéa facility. Noise and air quality are potential hazards throughout the subsurface installation.

On-site personnel will don hearing protection when drill rigs are active in the facility. Multiple drill rigs will likely be in operation, raising noise levels to levels higher than typically encountered during subsurface installations. TRS personnel will be provided with ear plugs and noise-reducing ear muffs. TRS personnel will wear both the ear plugs and the ear muffs during drilling tasks.

Indoor air quality will be a hazard due to primarily carbon monoxide (CO), carbon dioxide (CO_2), and low-level hydrocarbon emissions from the drill rigs. To combat the air emissions, the following engineering controls will be used to control and monitor air quality:

- Ducting from drill rig and truck exhaust pipes – routed to exhaust fans/exterior
- Scrubbers on vehicle exhausts
- Large diameter floor fans to direct exhaust towards exterior
- Use of 4-gas air quality meter to monitor CO and CO_2 levels
- Photoionization detector (PID) to monitor for VOCs

Additional drilling protocols and safe practices are outlined in **Section 3.8**. Additional air monitoring protocols and safe practices are outline in **Section 5.0**.

2.4. Welding Hazards

Due to the height restrictions in the subsurface installation area, welding of the TCH heater wells will be required. Pre-assembly will occur to the extent possible outside of the facility.

Welding is the act of joining materials together by melting a metal work piece along with a filler metal to form a strong joint. The welding process produces visible smoke which inherently contains harmful metal fumes and gas by-products. To minimize exposure to fumes while working indoors for this project, a portable fume extraction system (vacuum) will be in use. Forced ventilation may also be incorporated if conditions dictate (indoors and outdoors).

In addition to off-gas hazards, welding also generates intense radiation of visible light and invisible (infrared and ultraviolet [UV]) rays that can burn both eyes and skin. Welders will be required to don the required protective equipment of:

- Minimum of long-sleeve, cotton shirt, and long pants (under layer of clothing). Do not wear any polyester clothing.
- Welding helmet (with appropriate UV filter)

- Leather welder's gloves
- Welding apron
- Steel-toed boots
- Safety glasses with side-shields (under welding helmet)
- Ear plugs (to prevent entrance of hot metals into ear canal and noise reduction).

Never watch the arc from a welder without adequate UV eye protection, even at great distances, as this can irreversibly damage vision.

Welding requires an energy source to initiate and complete the process. Welding is most commonly accomplished with electricity or a flammable gas. For this project, tungsten inert gas (TIG) welding will be the preferred methodology. TIG welding involves an electrical current (through an electrode) connected to the object being welded and an inert shield gas (usually argon or argon mixture) that protects the weld during the process from oxygen and water vapor.

This process introduces electrical and compressed gas hazards. Prior to the day's activities, the activity hazard analysis (AHA) for welding tasks will be reviewed to note any changes in process or new hazards identified and controlled. The following best practices will be followed when welding activities are planned:

- Work areas will be clean and clear of debris and trip hazards
- Equipment will be inspected daily or at the beginning of each shift
- Inspect and don the proper PPE for the task
- Set up an exclusion to keep non-essential personnel away from the work area(s)
- Ensure work area is well ventilated and venting equipment (vacuum and/or pressure) is operational and functions as designed
- Ensure Hot Work Permit is completed before initiating welding activities
- Ensure fire extinguishers are available and ready for use
- Do not breath in generated fumes from the welding process
- Ensure nearby workers are aware of the tasks being performed and are not exposed to welding fumes
- Ensure welding electrode connection is true
- Ensure return ground is properly connected and sized appropriately
- De-energize equipment when not in use
- Store compressed gas cylinders vertically
- Valve protection caps should be in place when cylinders are not in use
- Store and use cylinders away from heat, sparks, and/or open flames

As with all hot work activities, the hot work permit protocols will be followed as outlined in **Section 3.11**.

2.5. Potential Chemical Hazards

Potential chemical hazards that may be encountered during project work include exposure to uncharacterized waste concentrated in soil, surface water, groundwater, remnant fluids in utility

lines, and air. Soil and groundwater at TRS ISTR sites are commonly impacted with CVOCs. Soil and groundwater may also contain petroleum hydrocarbons and other VOCs. The amount of chlorinated solvents found in soil and groundwater will be dependent upon the soil type, groundwater flow, weathering of the source area contaminants, and other factors. As CVOC-contaminated soil and water are disturbed and exposed to the air, contaminant vapors may evaporate from the soil and/or water and present an airborne hazard. The higher the ambient temperature, the greater the amount of vapor that may evaporate from soil and water.

CVOCs may enter the body through contact with skin and eyes, through ingestion, and through inhalation of vapors from volatized compounds. Most CVOCs are generally colorless liquid with odors varying from sweet, fruity, to chloroform-like (see **Table 4** for details regarding characteristics of OU3 COCs).

Intrusive activities such as concrete coring and cutting, drilling, and trenching have the potential to create airborne chemical hazards at the project location. Workers may need to don respiratory protection PPE during intrusive activities if dust or contaminant conditions warrant an upgrade in PPE. Respiratory protection PPE (air purifying respirator [APR] or particulate mask) should include P-100 filters. A negative pressure half-face or full-face APR with P-100 filter cartridges is recommended to provide increased respiratory protection over disposable particulate masks while conducting intrusive activities. See **Section 5.0** for details regarding airborne hazard monitoring.

NOTE: Odor should not be used as an indicator of the airborne hazard present as the nose can become desensitized to odors, and in some cases the solvent odor is not perceptible until airborne concentrations have already become hazardous. **Table 4** contains a list of CVOCs and VOCs historically observed at OU3, along with ionization potential of the compound, reported maximum concentrations (soil and groundwater), the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL), and additional characteristics. **Section 5.0** details the site-specific air monitoring program including air monitoring action levels for worker protection specific to this project.

2.6. Non-Chemical Airborne Hazards

Non-chemical airborne hazards that are present at an TCH site generally are limited to dust generated from: concrete/asphalt cutting, drilling activities, excavation activities, conductive fill placement (electrode construction), placement of well sand, and filling/extracting granular activated carbon (GAC) vessels.

During construction activities when workers crush, cut, grind, or drill materials that contain crystalline silica, very small and fine particles are created (respirable particles). Respirable particles can be inhaled during these activities which can lead to chronic and/or terminal illnesses after prolonged exposure over time. In most cases, the OSHA standard control methods for concrete cutting work in outdoor locations does not require additional respiratory protection. Since all concrete cutting, coring, and drilling activities will occur indoors for this project, an additional level of respiratory protection is required, even if the tool is equipped with integral water delivery system. See **Table 3** below for tasks anticipated during the project requiring dust respiratory protection.

Table 3. Respirable Silica Control Methods

Equipment/Task	Engineering and Work Practice Control Methods	Required Respiratory Protection & Minimum Assigned Protection Factor (APF)	
		≤ 4 hours/shift	>4-hours/shift
Hand-held power saws (any diameter blade)	• Use saw equipped with integrated water delivery system • When used indoors or in an enclosed area	APF 10	APF 10
Walk-Behind Saws	• Use saw equipped with integrated water delivery system that continuously feeds water to blade • When used indoors or in an enclosed area	APF 10	APF 10
Jackhammers and hand-held powered chipping tools	• Use tool with water delivery system that supplies continuous stream or spray at point of impact • When used indoors or in an enclosed area	APF 10	APF 10

Workers at the TCH remediation project, including TRS staff, Ramboll staff, and all subcontractors, are recommended to don respiratory protection PPE during activities presenting non-chemical airborne hazards (dusts and respirable particles) as outlined in **Table 3**. Respiratory protection PPE (APR or particulate mask) should include P-100 filters. A negative pressure half-face or full-face APR with P-100 filter cartridges is recommended to provide increased respiratory protection over disposable particulate masks when non-chemical airborne hazards are present. See **Section 5.0** for details regarding non-chemical airborne hazard monitoring.

2.7. Potential Physical and Biological Hazards

Potential physical hazards associated with work activities on-site include electricity, steam, heated water and COC vapors, pressured lines, lines under vacuum, vehicles, rotating equipment, machinery, pinch-points, lifting, drum handling, power tools, slips/trips/falls, work at height, heat/cold stress, physical stress/fatigue, dust, and noise. Refer to the applicable section of this HASP and applicable TRS SOPs and TRS AHAs for additional information on the hazards associated with a task and associated hazard mitigation.

Small animals and rodents may be encountered on-site. Other potential biological hazards include poisonous insects (spiders, ticks). Precautions should be taken to avoid direct contact with animals, insects, or plants (as applicable). If a bite, sting, or abnormal skin condition should occur, appropriate first aid and/or medical attention should be administered immediately. All cuts received on-site should be treated immediately.

All persons who will be assigned to work at the project who may be highly allergic to any plants, insects (stings, etc.), food, and susceptible to adverse reactions from such (i.e., anaphylaxis), will notify the SHSO and/or Site Supervisor prior to working on-site. This includes notification to the SHSO or Site Supervisor of any emergency medications or specific emergency response actions that may be needed for that person.

All staff working on-site should take precautions to limit exposure to the sun. The majority of the work is expected to take place inside the facility. Regardless, workers are encouraged to minimize the potential from overexposure to UV radiation from the sun. In addition, workers should use appropriate sunscreen to protect exposed skin from UV damage if tasks should be required outside of the facility. If an on-site worker experiences skin conditions associated with over exposure to the sun, they should be removed from direct UV exposure and appropriate first aid and/or medical attention should be administered immediately.

Table 4. Site-Specific Chemical Hazards

	Trichloroethene (CAS #79-01-6)	**cis-1,2-Dichloroethene (CAS# 540-59-0)**	**Tetrachloroethene (CAS #127-18-4)**
Maximum Reported Concentration	40 mg/kg	0.2 mg/kg	0.076 mg/kg
Permissible Exposure Limits (TWA)	100 ppm	200 ppm	100 ppm
Short- Term Exposure Limit	25 ppm	NR	25 ppm
IDLH	1,000 ppm	1,000 ppm	150 ppm
IE	9.47 eV	9.66 eV	9.32 eV
PID CF (11.7 eV) *	0.43+	None	0.31+
Boiling Point	87°C	60°C	121°C
Physical Properties	Colorless liquid (unless dyed blue) with a chloroform-like odor.	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.	Colorless liquid with a mild, chloroform-like odor.
Route of Entry	Inhalation, skin absorption, ingestion, skin and/or eye contact	Inhalation, ingestion, skin and/or eye contact.	Inhalation, skin absorption, ingestion, skin and/or eye contact
Symptoms	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	Irritation eyes, respiratory system; central nervous system depression	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen].
Target Organs	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system	Eyes, respiratory system, central nervous system.	Eyes, skin, respiratory system, liver, kidneys, central nervous system.

Notes: * = PID Correction Factor (CF) (ref.: RAE Systems Technical Note TN-106); TWA = time weighted average; IDLH = immediately dangerous to life and health; IE = Ionization Energy, NR = not reported, N/A = not applicable, ppm = parts per million, eV = electron volts

2.8. TCH System Operational Hazards

2.8.1. Arc Flash Hazards

The TCH equipment deployed for the remediation poses arc flash hazards based on the electrical energy associated with the electrical supply side to the TCH, VR, and treatment systems. An arc flash hazard is defined by the National Fire Protection Association (NFPA) 70E guidelines as, “a dangerous condition associated with the possible release of energy caused by an electric arc”.

Arc flash events are usually the result of an electrical short circuit. The hazards associated with an arc flash include extremely high temperatures, electrical shock, and injury from pressure waves resulting from the arc flash. Injuries associated with arc flash exposure can be severe (burns, eye injuries, shock, physical injuries) and commonly cause fatalities. Extreme caution should be used when working on electrical equipment that present arc flash hazards. All TRS equipment on-site that present arc flash hazards will be labeled in accordance with NFPA 70E.

TRS has prepared a Site-specific Arc Flash and Short Circuit Assessment (see **Appendix F**) that provides details regarding the specific arc flash hazards for TRS’ equipment in use for the remediation. This report is completed based on analyses of actual electrical hazards during the remediation which requires installation of primary electrical power to the TCH control system and ancillary TCH equipment. As such, this HASP will be amended to include the Arc Flash and Short Circuit Assessment when it is completed by TRS engineering personnel. All on-site staff are to review **Appendix F** as part of the Site-specific HASP review and sign the HASP Acknowledgement Form in **Appendix A**.

Note: Only competent persons trained and certified in NFPA 70E are permitted to perform electrical work on TRS equipment.

2.8.2. High Temperatures

The application of TCH will increase subsurface soil temperatures and increase the temperature of TCH heater well and VR system components. The TCH heaters will be installed using engineering controls to protect the operators from high temperatures during TCH operation. Following TCH shutdown, it may take several days or weeks for the TCH heaters and heater wells to cool below a safe handling temperature of 60°C or 140 degrees Fahrenheit (°F). Severe burns may result from contact with these components without the use of proper PPE; however, there are no planned activities that would require touching the TCH heaters while they are hot. Gloves providing protection from burns will be required to handle any soil sampling equipment during this period (see TRS SOP 3.2 for hot soil sampling). It is recommended that temperatures of any surface to be touched be first checked with a remote thermometer such as an infrared temperature monitor or thermal imager. Care should be taken regarding these temperatures for several weeks following shutdown of the TCH system.

2.8.3. Steam

Steam will be generated in the subsurface during operation of the TCH system and may be present throughout the remediation volume. In addition, steam may be present in the VR piping running from the VR recovery points in the vicinity of the remediation area to the ISTR condenser, and within the ISTR condenser.

Steam below the water table will have a positive pressure equal to the hydrostatic pressure at that depth. The subsurface will remain very hot after a TCH shutdown and steam generation can occur spontaneously if the hydrostatic head pressure is changed while groundwater is at the hydrostatic head boiling point.

Extreme caution must be taken to avoid exposing personnel to any source of steam. Any plans to access VR wells, or other equipment with exposure to the subsurface must first be approved by the TRS PM, the TRS SQM, and the start-up approving TRS employee, as addressed in TRS SOP 3.1 for hot groundwater sampling. Any activity where there is the potential for exposure to hot groundwater and/or steam will be first documented in a site- and task-specific AHA that will define task steps and processes, associated hazards, PPE, and mitigation requirements for each hazard. It is recommended to contact the TRS SQM prior to accessing any subsurface location that has the potential to expose workers to heated soil, steam, and/or volatilized contaminants. The TRS SQM will assist in the development of any site-specific AHAs for these activities.

2.8.4. Vapor Treatment

Vapor treatment during the TCH remediation will be accomplished by adsorption using vapor-phase GAC (VGAC). Contaminant vapors are routed through vessels containing VGAC. The vapor treatment system will be comprised of two VGAC vessels, plumbed in series, with a primary vessel and a secondary vessel.

At no time will TRS personnel enter the VGAC vessels for servicing or other activity. Entrance into a VGAC vessel is a permit-required confined space entry. Should a vessel need repair or maintenance, the carbon vendor will provide the personnel, materials, and equipment to make the repair or replace the unit.

Opening of the access ports or the influent/effluent connections poses a hazard risk to exposure to contaminant vapors. Caution will be emphasized when making connection changes or opening the access ports for visual inspection(s).

2.8.5. Activity Hazards Analysis

Each TRS AHA defines each major work task, associated activities, associated hazards, and mitigation efforts for those hazards. Copies of applicable TRS AHAs will be maintained in a binder at the TRS field office by the SHSO. Each AHA identifies the work tasks, the specific hazards anticipated, and the control measures to be implemented to reduce, mitigate, or control each hazard to an acceptable level. A major feature of work is defined as an operation involving a type of work presenting hazards not experienced in previous operations or where a new subcontractor or work crew arrives on-site to begin a new segment of the project. Each AHA that is reviewed should be updated as operations, procedures, local conditions, and equipment are altered during the project. Updated AHAs will be maintained on file at the TRS field office. Staff should notify the SHSO or TRS SQM of any changes that significantly improve AHAs and overall safety associated with a task.

AHAs should be reviewed prior to performing a task with all staff that will be involved in that task. AHAs are commonly reviewed during daily tailgate meetings or pre-task safety meetings conducted at the beginning of each work shift. During these AHA reviews, staff involved in the activity are encouraged to discuss site-specific conditions and edit or “dirty-up” the AHA to provide the best mitigation of hazards as possible.

3.0 PERSONAL SAFETY, HAZARD CONTROL, INJURY, AND INCIDENT PREVENTION

Personal injury and incident prevention are of the upmost importance to TRS. Incident prevention, injury prevention, and personal safety will be maintained on-site through strict adherence to the following policies and safe work practice measures.

3.1. Project Rules

All TRS personnel, TRS subcontractors, or others participating in on-site TCH activities with TRS must adhere to the instructions contained in this HASP. All project personnel must review this HASP, understand the information and requirements herein, and acknowledge their understanding of this HASP by signing the HASP Training Documentation form provided in **Attachment A**.

All on-site workers are required to attend training on restricted zones and exclusions zones within the designated work areas and will document their training by signing the Restricted Zone Acknowledgement form in **Appendix A**. TRS on-site personnel will conduct this entry training as needed for all workers coming on-site. No person shall enter any restricted zone or exclusion zone without this training. Guests and visitors may enter the work area(s) only when escorted by TRS on-site personnel.

Contact with contaminated or suspected contaminated surfaces and materials should be avoided. Whenever possible, walking through puddles or discolored surfaces, kneeling on the ground, leaning, sitting, or placing equipment on drums, containers, exposed soil, or the ground should be avoided.

Medicine, alcohol, and illegal drugs can increase the effects from exposure to toxic chemicals. Personnel should not take prescribed drugs where the potential for adsorption, inhalation, or ingestion of toxic substances may exist, unless specifically approved by a qualified physician. The possession and intake of illegal drugs while on-site is prohibited. It is strictly prohibited to be under the influence of or use illegal drugs or alcoholic beverages while on-site, while operating machinery on-site, or operating a TRS company vehicle at any time.

3.1.1. General Housekeeping

Work zones will be kept clean and waste and debris will be removed daily. Any used PPE (gloves, Tyvek®, respirator cartridges, etc.) that have potentially encountered any non-aqueous phase liquid (NAPL) or other contaminants will be stored in a drum and properly labeled prior to disposal. Tools and materials will not be strewn about in a manner that may cause tripping or other hazards. Tools and materials will be collected and returned to their storage area following the completion of tasks. Stored materials will be placed and stacked in a manner that is stable and secured against sliding or collapse. All slip/trip/fall hazards will be eliminated wherever possible. Where slip/trip/fall hazards cannot be eliminated, the hazard will be guarded, and warning signs posted in the vicinity of the hazard.

3.1.2. Lone Worker Policy

There may be occasions were TRS staff may be working alone on-site. Having a lone worker at a TRS site presents elevated hazards and should only occur when necessary. When any TRS staff is working alone on-site, the following procedures will be followed:

1. The PM and the lone worker will also establish a mutually beneficial procedure for ISTR system responses that occur outside of normal working hours. If the lone worker is required to respond to a system upset or shutdown during normally non-waking hours, the PM and lone worker will establish the best method(s) of notification. For example, after 10 PM, the lone worker would provide just text notifications of arrival and departure from the site. The PM, in this scenario, would need to confirm receipt of the texts and be on "standby" to ensure the lone worker does not request technical assistance and confirm the lone worker leaves the site. A lone worker responding to system upsets outside of normal working hours must ensure they have the security system FOB in their possession before investigating system upsets or shutdowns.
2. During normal working hours, and once on-site, the lone worker will contact and check in with the TRS PM, or their designee. The check-in will be made prior to commencing any field activities/tasks. At this time, the lone worker and the TRS PM will establish the day's check-in schedule for periodic updates of the lone worker's status. These check-ins can be verbal or written electronic message (e-mail or text) in nature. If planned tasks include activities with an elevated safety risk (e.g.; working at heights), additional check-ins will be made prior to and upon completion of higher-risk tasks. Activities with an elevated safety risk require the donning of PPE beyond the standard Level D field work clothing of steel-toed boots, hard hats, safety glasses, nitrile and/or leather gloves, and high-visibility outer garment(s). Examples of non-standard PPE include, air-purifying respirators, arc flash PPE, fall arrest/protection devices, splash protective clothing w/face shields, etc.
3. The security system for the project includes three (3) FOBs for arming/disarming the security system. These FOBs are also equipped with the ability to request emergency services assistance (this function is also available on the security system control keypad). If the lone worker experiences an injury or perceives imminent danger (e.g., an armed intruder), the lone worker can depress the button with the red star ("panic button") to request emergency services. Depression of the "panic button" will also cease energy distribution to the ISTR treatment volume. Lone workers will carry one of the security system FOBs during their work shift(s) to use in a case of emergency. A lone worker responding to system upsets outside of normal working hours must ensure they have the security system FOB in their possession before investigating system upsets or shutdowns.
4. Consistent with the TRS Behavior Based Safety (BBS) program, any employee working alone at the project will complete and document a daily tailgate meeting, noting that they are working alone. If the tasks or working conditions for a given day change, the lone worker will conduct an additional tailgate meeting or pre-task analysis to identify hazards, proper procedures, and PPE required. The lone worker will notify the PM or their designee of the change in tasks and/or work conditions when they occur.
5. In situations that there are multiple employees on-site, but then conditions or schedules change and dictate a lone worker scenario, the remaining lone worker on-site will contact the PM or their designee and update the PM of the change to the on-site employee status. This scenario also applies to travel days when the last person on-site is the remaining employee and responsible for prepping the remediation system for unattended operations and securing the work area(s) prior to departure. The previous procedures will be followed for the remainder of the lone worker's shift/assignment.

6. Prior to leaving the project site at the end of the work day, the lone worker will notify the PM or designee of their departure from the project site. Communication can be verbal or via electronic message.

3.1.3. Fire Protection and Prevention

The appropriate number of 20A-80 B and/or C-rated fire extinguishers will be kept on-site during field activities. During operations, one 15-pound (lb) (minimum) carbon dioxide (CO_2) fire extinguisher will be kept on-site near the TCH control system location. The following are the recommended fire extinguishers and locations for the project:

- TCH control system location: one 15-lb (minimum) CO_2 extinguisher near each entry way
- Equipment Compound: one 10-lb (minimum) A-B-C extinguisher near each VR blower, one 10-lb (minimum) A-B-C extinguisher near each ISTR condenser
- Electrode Field(s): one 10-lb A-B-C fire extinguisher per 3,000 ft^2 of area
- Office Trailer/Work Trailer (if applicable): one 5-lb (minimum) A-B-C extinguisher

Note: There may be multiple systems and VR equipment in place within the TCH equipment compound. Additional fire extinguishers may be required based on the final placement of TCH equipment.

3.1.4. General Field Activities

The following list is provided as guidance for general field activities.

- All TRS personnel, TRS subcontractors, or others participating in on-site activities with TRS must be adequately trained and thoroughly briefed on anticipated hazards, protective equipment to be worn, safety practices to be followed, and emergency response and communication procedures.
- At no time during TCH power application shall any person enter an Exclusion Zone
- Work areas for various construction and operational activities will be established, as needed. Keep non-essential personnel out of the work area.
- A support zone (SZ) will be maintained at all times.
- All personnel entering work zones must wear the designated PPE for the area.
- Loose-fitting clothing or jewelry, or exposed long hair is prohibited around moving machinery.
- All electrical equipment (power tools, extension cords, etc.) shall conform to Title 29 of the Code of Federal Regulations (CFR) Part 1926.400 (29 CFR 1926.400) Subpart K.
- Be certain that corded electrical equipment and tools use three-wire grounded extension cords.
- All hand and power tools on-site will be maintained and used in accordance with the manufacturer's directions and specifications and visually inspected prior to use.
- Inspect tools and moving equipment to ensure that parts are secured and intact with no evidence of cracks or areas of weakness and that it is operating according to manufacturer's specifications.
- Store tools in clean, secure areas so that they will not be damaged, lost, or stolen.

- At the start of each day, inspect brakes, hydraulic lines, light signals, fire extinguishers, fluid levels, and steering on each piece of heavy equipment. Equipment inspections should be documented using the Heavy Equipment Inspection form provided in **Attachment A**.
- Adhere to procedures defined by applicable TRS SOPs and AHAs.
- Adhere to procedures defined in NFPA 70E regulations for arc flash and voltage protection.

3.1.5. Signs/Labels

Signs and labels will be used to clearly mark containerized waste materials, supplies, etc. Signs will be used to clearly mark dangerous areas, chemical storage areas, restricted areas, and specific work zones. During operations, hot surfaces and high voltage areas will be clearly identified and high voltage/no dig signs will be posted around the perimeter of the TCH Restricted Zone. TCH applicable equipment will have labels for arc flash and voltage hazards in accordance with NFPA 70E. Other on-site hazards (such as pressurized steam lines) will be labeled accordingly.

3.1.6. Eating/Drinking/Smoking

Eating, drinking, placement or removal of gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area that has been designated as contaminated, designated Hazardous Waste Operations (HAZWOPER) EZ, within the TCH treatment area, or TCH equipment compound. It is recommended that the TRS SHSO establish a designated smoking/tobacco use area at the facility that is consistent with the client's and the property owner's property use guidelines.

3.1.7. Sanitation

Sanitary facilities will be provided for project personnel near the TCH equipment compound and/or office trailer. This includes a hand wash sink (or suitable equipment for sanitizing hands) and toilet. Personnel will thoroughly wash/sanitize hands before eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material.

Whenever decontamination procedures for outer garments are in effect, the entire body shall be thoroughly washed as soon as possible after the protective garment is removed.

3.2. Site Control Measures

Due to the nature of the work to be performed and the hazards described in **Section 2.0**, the facility will have strict access control requirements. Access to the TCH treatment area and TCH equipment compound(s) will be restricted to authorized personnel from Ramboll, TRS, TRS-approved subcontractors, and visitors approved by the TRS PM or Site Manager and the TRS SHSO. A log of personnel visiting, entering, or working on-site will be maintained by TRS (the daily tailgate meeting form may serve as a log of on-site visitors). All visitors will receive a health and safety briefing from TRS prior to entering designated work areas.

During the construction phase, Ramboll and TRS, will maintain control into remediation work areas. A temporary, chain link security fence will be installed surrounding the exterior of the TCH equipment compound and will be locked during operations when staff are not on-site.

Unless specifically arranged with Ramboll, work hours during the operational phase of the TCH project will be restricted between 7:00 a.m. to 6:00 p.m. daily, Monday through Friday, excluding

federal holidays. However, TRS personnel may require access to the TCH treatment area or equipment compound outside of established working hours to respond to system shutdowns or upsets. TRS will co-ordinate with Ramboll regarding work area access during non-work hours.

During the operational phase, no one may enter the restricted zone (TCH equipment compound and TCH treatment area) or sample monitoring wells within the TCH treatment area until they have been trained by TRS and signed the associated Restricted Zone Training Acknowledgement Form (**Appendix A**). Prior to performing work in the restricted zone that could expose personnel to contaminants or heated objects, trained TRS personnel must lockout/tagout (LOTO) any applicable equipment in accordance with TRS SOP 1.1 Lockout Tagout. Only trained and qualified TRS personnel are permitted to perform LOTO on TRS equipment and will require other affected personnel to participate as required per LOTO protocol.

3.2.1. Traffic Control

The location of the TCH treatment area is within the Albéa property. Entry into the Albéa property will be from the south entrance off Route 31. The north entrance is designated for Albéa's shipping and receiving traffic. During TCH system installation, traffic within the property boundaries will be limited to drill rigs, delivery vehicles (tractor trailers and delivery vehicles), and support vehicles. Traffic pathways will be delineated inside the facility to maintain safety.

In addition to signage and other marking devices (cones) to manage traffic flow, TRS will use spotters for traffic control for equipment and material deliveries and other similar activities. TRS requires spotters (if available) any time that heavy equipment (forklift, skid-steer, excavation machinery, hoisting equipment, etc.) is in use. Spotters will have no other responsibilities while spotting vehicles/equipment and will be dedicated to observing the activity. Any staff acting as a spotter for traffic control will wear hard hats and high visibility (Hi-Vis) outer garments (vest, shirt, or jacket) meeting American National Standards Institute (ANSI) Class 2/Type R standards. Traffic control measures may include the following:

- Traffic cones or similar temporary warning devices
- Temporary fencing
- Traffic signage (see below)
- Traffic observers and/or flag-men (spotters)

Signage to control traffic and to direct delivery trucks to TRS will include:

- One large sign at the entrance gate to the facility

Depending on facility conditions, traffic flow, ongoing on-site work, and/or equipment on-site, the TRS PM, with consultation with Ramboll and Albéa facility personnel, may alter traffic control to provide safe working conditions for project staff and for vehicles driving in the vicinity. Any changes to existing traffic control will be reviewed with all on-site staff and documented during the daily tailgate meeting and/or as changes are required.

3.2.2. Security

Security fencing will be installed around the TCH equipment compound and any above ground infrastructure. The fenced area will inhibit entrance by unauthorized personnel (see **Figure 3** for Site details).

The TCH treatment area will be barricaded to prevent unauthorized entry during all phases of the project.

To prevent access from unauthorized personnel during TCH operations, a motion detection security system and a motion activated video system will be installed within the secured area covering the TCH treatment area and TCH equipment compounds. As a crucial project safety component, when any motion alarm within the TCH treatment area or TCH equipment compound is triggered, it will instantly de-energize the TCH heaters via interlocks with the TCH control system providing power to the heater field. All vapor and/or groundwater treatment equipment will still remain operational. Only power to the TCH heaters will be de-energized. This component of the security system will protect an intruder from possible injury associated with electrical shock. If unauthorized entry is detected, TRS personnel will be notified by a security vendor that the system was shut down due to restricted zone breach. If the breach was due to a false alarm, the system will be remotely restarted following a visual inspection using the security cameras and/or field personnel to ensure no damage or malicious acts were performed to TCH system components or equipment. If a true security breach is observed, the local police department will be called to inspect the treatment area/equipment compound to ensure the intruder is gone. Upon confirmation from the local police department, TRS can restart the system via remote connection.

3.2.3. Construction and Sampling Work Zones

Decontamination of personnel, vehicles, and equipment is required prior to leaving the work area. Work zones will be clearly identified for on-site personnel and visitors. Work zones during construction and sampling will consist of the following:

- Exclusion Zones (EZ)
- Contamination Reduction Zones (CRZ)
- Support Zone (SZ)

The SZ will be free of contamination or physical hazards. In the SZ, training and PPE requirements will be equal to the lowest levels allowed on-site. The TRS PM and SHSO will ensure that access to the SZ is regulated at the perimeter fence line.

Exclusion Zones may be established to protect on-site personnel and visitors' exposure to chemical and/or electrical hazards. In the case that an EZ is established associated with the TCH work, TRS will always maintain sole control of any EZ. Any EZ that is established to prevent exposure to electrical hazards will be off limits to any on-site personnel until the hazards are controlled.

The TRS PM and SHSO will ensure that access to the EZs is restricted to properly trained employees who need to enter the zone and who are wearing the proper PPE. It is anticipated that the areas around an active drill rig will be the only established EZs. All EZs will be clearly demarcated using an appropriate combination of caution tape, barriers, and signage.

The CRZs will be established between any EZs and the SZ. Personal decontamination will take place in the CRZ. The TRS PM and SHSO will ensure that all employees, materials, supplies, and equipment leaving an EZ pass through a CRZ and are properly decontaminated. All CRZs will be clearly demarcated using an appropriate combination of caution tape, barriers, and signage.

Other areas of the work area(s) may be demarcated as controlled access areas, but not EZs. These may include haul routes, loading and off-loading areas, storage areas, and portions of the treatment

area during TCH system start-up. These areas will be clearly demarcated using an appropriate combination of caution tape, barriers, and signage.

3.3. Severe Weather

This area of the country may be subject to severe and sudden changes in weather. Specific weather-related hazards may include:

- Thunder and lightning storms
- Tornados
- Blizzard conditions and/or heavy snow
- Flash flooding

The SHSO will monitor the weather on a routine basis using an appropriate smart phone weather application ("Weather Bug" or equivalent weather notification). The SHSO will keep on-site personnel informed of weather conditions and make arrangements for shelter and work stoppage dependent upon weather conditions. Details regarding weather related emergency response are provided in the Site-specific Emergency Response Plan (ERP) in **Appendix E**.

3.3.1. Lightning

When data is available, TRS outdoor, on-site work will be suspended when lightning strikes within a 10-mile radius of the work area. If data is unavailable, the 30-second rule should be followed. The 30-second rule is based on the speed of sound, which is roughly 700 miles per hour (mph). At that rate, it takes about five seconds for a sound wave like thunder to travel one mile. If you start counting the number of seconds after a lightning flash, and you keep counting until you hear the thunder, you can then divide by five to get the distance to that flash in miles. Once lightning has moved to within about five or six miles of the work area, there is a high risk for getting struck. The SHSO or their designee, will review forecasted weather and monitor lightning and associated thunder when appropriate. A smart-phone application capable of providing local lightning strike information (i.e., Weather Bug) is recommended for monitoring these weather conditions. Appropriate action in the case of lightning work stoppage and muster locations will be discussed at the tailgate meeting on days when the weather forecasts indicate possible lightning strikes. See **Section 13.4** for information on muster locations and the ERP for emergency response procedures.

3.3.2. Tornadoes

A tornado is a violently rotating column of air extending from the base of a thunderstorm down to the ground and can occur with little or no warning. They can destroy well-made structures, uprooting trees, and hurling objects through the air at high speeds.

The SHSO or their designee will monitor weather while on-site for indications of tornadoes. Appropriate action in the case of a tornado, work stoppage, and muster locations will be discussed at the tailgate meeting on days when the weather forecasts indicate possible severe weather. In the case of a potential tornado, the SHSO or Site manager will sound a warning of three blasts from an air horn or similar device (i.e., car horn) to notify on-site personnel to stop work and immediately report to the primary muster point. See **Section 13.4** for information on muster locations and the ERP for specific emergency response procedures.

3.4. Heat Stress

Heat stress is a major hazard especially for workers wearing protective clothing. Heat-related illnesses range from heat stress to heat exhaustion and heat stroke. Careful training in the use of PPE (including periods of acclimatization), frequent monitoring of personnel wearing protective clothing, judicious scheduling of work and rest periods, and frequent replacement of fluids can protect against this hazard. Areas of shade will be available for all staff on-site and including an air-conditioned work/office trailer.

When daily average heat index exceeds 85°F, the TRS Site Supervisor or SHSO will develop a heat stress plan for the day. That will plan will include, but not be limited to, periodic rest/rehydration breaks, and monitoring of staff for signs and symptoms of heat stress. Personnel will be monitored by the SHSO for the amount and frequency of liquid intake, frequency of breaks, and the appearance of heat stress symptoms. A person will be assigned to execute the plan and ensure that required breaks are taken and the plan will be reviewed at the daily tailgate meeting.

The symptoms and/or warning signs for the early stages of heat stress include rashes, cramps, discomfort, rapid pulse, drowsiness, and impaired function. Treatment for early stages of heat stress includes rest in a cool setting and fluid intake.

Continued heat stress if untreated, could lead to heat stroke which can cause irreversible damage or even death. The major symptoms of heat stroke include dry - hot skin temperature (the body's natural perspiring mechanism has ceased to function properly), dizziness/disorientation, nausea/vomiting, diminished or loss of motor function, impaired vision, and unconsciousness. Thus, heat stroke requires immediate treatment, which includes:

- Immediately notify the Site Supervisor of the heat stroke victim and contact emergency services (call 9-1-1) and proceed with treating victim.
- Remove victim's protective outer clothing.
- Unless the victim is obviously contaminated, omit or minimize decontamination and begin treatment immediately.
- Immediately cool the victim's body. This should include moving the victim to a cool, shaded area and applying cool, wet towels or ice wrapped in towels (do not apply ice directly to bare skin). Target cooling areas on the body include the head and neck areas, armpits, and crotch (areas where blood flow is near the skin surface).
- Continue to monitor the victim's condition and vital signs every five minutes until emergency medical assistance arrives. Provide a record of the vital signs, observations, and times to the emergency medical personnel.

When on-site personnel are in Level D and C PPE, physiological monitoring shall commence when the ambient temperature is above 29.5°C (85°F). This monitoring will be performed by the SHSO (or their designee) and co-workers. The Physiological monitoring shall include:

- Watch for changes skin color, rashes, excessive sweating, or cessation of sweating.
- Ask personnel about rashes, cramps, and discomfort.
- Observe personnel for signs of drowsiness and impaired ability to think or function.
- Measure pulse and the time it takes for a rapid pulse to return to normal once stress has been removed or reduced.

- Monitoring frequency shall increase as the ambient temperature increases or as slow recovery rates are observed. An adequate supply of cool drinking water shall be provided for the workers.

3.5. Cold Stress

Cold injury (frostbite and hypothermia) and impaired ability to work are dangers at low temperatures or when the wind chill factor is high. Personnel will wear appropriate clothing, have warm shelter readily available, schedule adequate work and rest periods, and will monitor their co-worker's physical ability. Cold weather requirements:

- If wind chill is a factor at the work location, the cooling effect of the wind can be reduced by shielding the work area or providing employees an outer garment to act as a windbreak.
- Extremities, ears, toes, and noses will be protected from extreme cold by protective clothing.
- Employees exposed to wet weather will wear a layer of clothing which is impermeable to water.

Workers will notify the SHSO if they are suffering from illnesses or taking any medication, which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. These workers will be excluded from work in cold (30°F or below).

3.6. Vehicle Safety

Cabs of vehicles will be free of non-essential items and loose items will be secured to prevent movement within the vehicle. Do not allow the rated load capacity of a vehicle to be exceeded. Heavy equipment will be inspected daily prior to use and documented in the Heavy Equipment Inspection form included in **Appendix A**. Confirm that all appropriate guards are in working condition. These may include rollover protective structures, seat belts, emergency shutoff in case of rollover, and backup warning lights and signals. Equipment operators will report abnormalities such as equipment failure, leaking liquid, unusual odors, etc. to their supervisor(s), the SHSO, or the PM. Blades and buckets will be lowered to the ground and parking brakes set before vehicles are shut off. Wheels of vehicles will be chocked when not in use for extended periods.

During all phases of the TCH project, there will be instances when vehicles will be required to maneuver off clearly marked roads or pathways. While maneuvering vehicles through these areas of the project site, and any areas of limited visibility, a spotter will be implemented to provide the safe mobility of the vehicle through the project site. The spotter should remain visible to the vehicle operator as long as the vehicle is in motion. If the operator should lose visual contact with the spotter during mobilization of the vehicle, the operator shall stop the motion of the vehicle until visual contact with the spotter is re-established.

A spotter is required any time that heavy equipment (i.e., forklift, skid-steer, excavation machinery, crane) is in operation. When driving any vehicle in reverse, a spotter will be used if one is available on-site. If no spotter is available, drivers should avoid driving in reverse or where vision is limited. If a driver must drive in reverse or in areas of limited vision without a spotter, the driver should exit the vehicle and confirm that a clear driving path is available. Spotters will have no other responsibilities while spotting vehicles/equipment and will be dedicated to observing the activity.

Any staff acting as a spotter for traffic control will wear hard hats and Hi-Vis outer garments (vest, shirt, or jacket) meeting ANSI Class 2/Type R standards

Cellular or mobile phone use is prohibited during operation of any motor vehicle or heavy equipment at the Albéa property and surrounding community. If personnel are required to make a call during operation of a vehicle, personnel will stop the vehicle at a safe location and secure the vehicle from movement (place motor vehicle in park, set heavy equipment in the neutral position and set parking brake, etc.) before taking or making a call.

Vehicle and equipment operators will operate all vehicles/equipment in accordance with New Jersey state laws and posted local municipality requirements. Operators will not exceed local speed limits.

3.7. Equipment and Machine Guarding

Be certain that equipment has appropriate guards and engineering controls. Belts, gears, shafts, pulleys, sprockets, spindles, flywheels, chains, or other reciprocating, rotating or moving parts of equipment will be guarded if there is a possibility of human contact or when they otherwise create a hazard. TRS and its subcontractors will adhere to other applicable provisions which require backup alarms consistent with OSHA requirements.

3.8. Drilling

Drilling activities to install TCH subsurface equipment falls under the scope of work for TRS. TRS personnel will be on-site during TCH component installation activities (drilling). The following list provides guidance to TRS personnel for drilling oversight activities:

- Hard hat, hearing protection, gloves, eye protection, Hi-Vis vest (or equivalent), and safety shoes will be worn by all TRS employees involved in drilling activities, and by employees required to work in the immediate vicinity of drilling activities.
- Based on current working conditions and work activities, specific worker breathing zone air monitoring programs will be established by the SHSO daily. Air monitoring results will be recorded in a log by the SHSO (or their designee) and maintained on-site. See **Section 5.0** for details regarding air monitoring and associated action levels for the project.
- Depending on worker breathing zone monitoring, workers at drilling locations may be required to wear respirators. All drilling personnel (including oversight personnel) are required to have record of current respirator fit testing (less than one-year old). All drilling personnel and others involved in drilling activities are required to have respirators on-site and readily available during these tasks. If needed, TRS can provide respirators upon request and additional fit testing would be required for any respirators provided.
- Only trained and authorized personnel will operate the drill rig and associated equipment. TRS personnel will not operate drilling equipment or associated support equipment.
- At no time will any personnel be allowed to climb the mast of a drill rig while it is in the upright position without appropriate fall protection and fall protection equipment training.
- The mast will be lowered prior to moving the drill rig.

- Care will be taken to avoid slips/trips while working on uneven, wet, or plastic covered surfaces. To the best extent possible, slip/trip/fall hazards will be mitigated at each drilling location.
- There will be no walking, standing, or crawling under a suspended load.
- All personnel will be trained on the location and function of all “kill-switches” on the drill rig prior to beginning drilling operations; all kill switches will be tested at the start of each shift.
- On-site personnel will not approach an operating drill rig without establishing communications with the drill rig operator.
- Clear paths of egress from drilling locations will be maintained at each drilling location during drilling operations.
- When operating drilling equipment in the vicinity of overhead power lines, heavy equipment and personnel will maintain the minimum distances specified by OSHA regulations 29 CFR 1926.1408. The requirements for these minimum distances are provide in **Table 5.**

Table 5. Safe Distance from Overhead Power Lines

Voltage of Power Line (kV)	Minimum Distance to be Maintained from Power Line*
Up to 50kV	10 feet
Over 50kV to 200kV	15feet
Over 200kV to 350kV	20 feet
Over 350kV to 500kV	25 feet
Over 500kV to 750kV	35feet
Over 750kV to 1,000kV	45 feet
Over 1,000kV	Safe working distance will be established by the utility owner/operator or by a qualified engineer experienced in electrical power generation and transmission

Notes: kV=kilovolt; * = OSHA regulations 29 CFR 1926.1408 Table A

3.9. Confined Space Entry

According to CFR 1910.146(b), "Confined space" is defined as a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.)
- Is not designed for continuous employee occupancy

A “permit-required confined space” has the above characteristics, plus one or more of the following characteristics:

- Has the potential to contain a hazardous atmosphere

- Contains a material with the potential to engulf an entrant
- Has an internal configuration that might cause an entrant to become trapped or asphyxiated?
- Contains other recognizable safety or health hazards

The only known potential confined spaces at the project site associated with the TCH equipment is the cooling tower. This is a non-permit confined space. Confined space entry is not anticipated under this contract. If a "permit-required confined space" is identified on-site, then TRS will communicate this requirement to employees, sub-contractors, and visitors using proper signage.

The interior of the condenser container does not meet the requirements of a confined space per applicable OSHA regulations as it is designed for human occupancy. However, a portion of the work area within the condenser container is limited, presents trip and overhead hazards, and may contain hazardous atmospheres. Workers entering the condenser should use caution regarding physical hazards and open the doors of the condenser on both ends for ventilation prior to entry. The doors should be open for a period of five minutes and the breathing zone screened with a PID prior to personnel entering the condenser unit.

3.10. Fall Protection

In accordance with OSHA regulations outlined in 29 CFR 1926 Subpart M, each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems. Minimum fall protection is anticipated on this project and will be associated with the installation and demobilization of the condenser/cooling tower units. During condenser/cooling tower assembly/disassembly, personal fall protection equipment (fall harness, lanyards, self-retracting lifelines, etc.) will be worn by staff performing work above 6-feet where other approved fall protection (guardrail systems, etc.) is not present. In addition, should personnel require fall protection for certain, short term activities (e.g., access to crane or drill derricks), only competent, trained personnel shall conduct the work activities. For all activities conducted at a height of 6 feet or greater above the next lower level/platform, each employee will wear a harness and lanyard when appropriate (i.e., when there is a reasonable and stable place to hook the lanyard).

Portable ladders will be used in accordance with 29 CFR 1926.1053(b)(1). When portable ladders are used to access an elevated work area, the ladder shall extend at least three feet above the working surface. In the case that the ladder cannot be extended the required three feet, the ladder will be secured to prevent the accidental movement of the ladder during use. As a rule, fall protection is not required for ladder use to access elevated work areas.

3.11. Hot Work

Hot work includes tasking involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations. Heat shrinking and grinding activities are the only hot work anticipated under typical TRS contracts. Other atypical hot work tasks include thawing of pipework with heaters, soldering, brazing, or sweating copper pipe, applying heat for seized hardware, metal fabrication (cutting or sawing), and welding of metal components.

All activities associated with potential hot work will require completion of the TRS Hot Work Permit and will follow the appropriate safety protocols (i.e., fire extinguisher available nearby). The TRS Hot Work Permit is provided in **Appendix A**.

Prior to any hot work, flammable materials and/or combustible materials will be removed from the work area to a safe distance away from the hot work (minimum distance of 35 feet). Combustible materials include, but are not limited to:

- Construction materials (wood, roofing materials, plastics, insulation, etc.)
- Flammable or combustible liquids or gases (gasoline, paint, propane, etc.)
- Organic material (grass, hay or straw, wood chips, trees, shrubs, etc.)
- Paper products (paper, tissue, cardboard, shipping materials, etc.)
- Fibers and cloths (rags, clothing, furniture, window coverings, etc.)

A fire-watch will be established in accordance with the TRS Hot Work Permit. The fire-watch will continue for a minimum of 30 minutes following the hot work or for a longer duration as described in the TRS Hot Work Permit for the task.

The following conditions require the implementation of a fire-watch

- Work is being done in an area where a fire could develop
- Combustible materials are within 35 feet of the hot work
- Combustible materials are greater than 35 feet away but can be easily ignited by sparks (check SDS or manufacturer's recommendations)
- There are doorways within 35 feet
- Combustible materials are stored in adjacent spaces

If all the conditions listed above can be eliminated, then the fire-watch can be omitted. The hot work permit still requires completion and signature prior to initiating the work.

3.12. Excavation and Trenching

Trenching and/or excavations where the depth is greater than 4 ft bgs are not expected for this project. In the case that any excavation does exceed 4 ft bgs, these excavations will be constructed in accordance with the requirements of OSHA Standard 29 CFR 1926.652 for trenching safety. For trenches greater than 4 feet in depth, means of egress shall be installed at distances no greater than 25 feet. For trenches or pits greater than 5 feet in depth, a protective system (benching, sloping, shoring, etc.) shall be constructed and approved by a competent person for excavation safety. All health and safety practices for general construction will be followed including requirements for workspace housecleaning and exposure to falling loads. All excavation spoils will not be piled/stored any closer than three feet from the edge of any excavation.

3.13. Hoisting and Rigging

All hoisting and rigging operations will follow the guidelines set forth in 29 CFR 1926.753, Safety and Health Regulations for Construction, Hoisting and Rigging; OSHA Document 3072 (1996), Sling Safety; OSHA requirements, and applicable state of New Jersey requirements. In accordance with OSHA regulations 29 CFR 1926.1410, minimum distances from energized overhead power lines

specific to lifting and hoisting will be maintained. The requirements for these minimum distances is provide in **Table 5.**

A lifting plan will be prepared and reviewed prior to initiating any critical lift. A critical lift is defined as a lift that either exceeds 75 percent of the rated capacity of the crane or derrick or requires the use of more than one crane or derrick. At least three days prior to crane work, hoisting/rigging subcontractors will provide a lift plan and AHAs (or equivalent) to TRS for their work to be performed. The TRS SHSO will determine if a critical lift exists and may also require a lifting plan for other large or unusual loads. AHAs for crane work and lifting and lift plans (if applicable) will be reviewed at a pre-task safety meeting with all personnel involved in hoisting and rigging. TRS staff will oversee all crane work and lifting however, TRS staff will not act as riggers or assist with any lifting or rigging work outside of directing placement of TRS equipment and/or associated lifting activities.

3.14. Material Handling

On-site personnel will observe the following protocols to prevent incidents of hazards and injury related to lifting and moving of equipment and materials on-site:

- Drums will be pumped prior to moving if the integrity of the drum skin is questionable.
- Personnel will ensure that all container covers, drum lids, bungs, caps, and other sealing devices are in place and properly tightened prior to moving any material container.
- Personnel will be trained in proper lifting and moving techniques and will only move items of reasonable weight and dimension by hand.
- Before moving anything with a forklift, the forklift operator will determine the most appropriate sequence in which the various items should be moved.

3.14.1. Moving/Lifting

Employees performing repetitive motion tasks will take breaks to avoid injury. When lifting objects is necessary, employees will follow safe lifting practices. Bend the knees, keep the back straight, keep the object as close to the body as possible, and lift with the legs. If the object is large or awkward, employees will get help with lifting. Always clear a pathway before moving an object. When possible, use carts, hand trucks, or a push/pull technique to move the object.

3.14.2. Spill Prevention and Containment

TRS and its subcontractors will store, handle, and transfer fluids to prevent the release or spill of oil or other potentially hazardous materials. Materials that are likely to be used in construction equipment include polyvinyl chloride (PVC) glue and primer, gasoline, diesel fuel, hydraulic fluid, and lubricating oils. A chemical inventory list of materials expected to be on-site is provided at **Appendix D** and copies of Safety Data Sheets (SDS) for chemicals on-site will be maintained in a binder on-site by the SHSO. Materials that are likely to be used or stored on-site during operations include diesel fuel and drums or tanks containing waste material extracted from the subsurface (temporary).

Separated storage areas will be created for the various types of waste and debris (including used PPE) associated with the removal. Signs and labels will be used to clearly mark containerized waste materials, supplies, etc.

Specifications for tanks and containers must meet generally approved standards; including but not limited to suppliers' recommendations and specifications of the United States Department of Transportation (DOT). In meeting these standards, TRS will ensure that tanks and containers maintain their integrity and be of a condition acceptable for storage and transportation. All storage tanks containing liquids will have a secondary containment capable of holding 110 percent of the tank capacity. All flammable materials will be stored in appropriate containers and in a designated flammable materials cabinet.

Secondary containment systems will be placed under the ISTR condenser/cooling tower unit(s) and associated liquid-phase granular activated carbon (LGAC) vessels. The secondary containment systems will have the capacity to hold 110 percent of the total fluid volume contained within these units.

An appropriate spill response kit (minimum 25-gallon capacity) will be staged in the immediate vicinity of any TCH equipment secondary containment unit. Any fuel (diesel and gasoline) stored on-site will be stored in Type 1 containers and in a secondary containment tub (or equivalent) capable of holding 110 percent of the volume of the fuel container(s).

3.14.3. Material Transfer Safety

Volatile liquids and residues shall be removed from storage tanks using explosion-proof or air driven pumps. All pumps and transfer equipment requiring an electrical power source will be properly grounded using Ground Fault Circuit Interrupters (GFCI). Storage and temporary containers will also be grounded during materials transfers.

Transferring liquids and refueling will occur only at approved locations that are at least 100 feet away from any wetlands or surface waters, and 200 feet from any private, municipal, or community water supply. On-site personnel will have adequate spill response equipment available at the dispensing or transfer location. Any liquids will be collected in suitable containers and appropriately disposed. Transfer lines will not be left unattended when in use and will either be held or secured in place throughout the transfer process.

Refueling of vehicles will be performed off-site. In addition, only the qualified vendor providing propane tanks (if used) will refuel these tanks on-site.

TRS personnel shall contact the TRS PM and TRS SHSO for non-routine materials handling events. The TRS SHSO will be responsible for developing any task-specific AHA.

3.15. Site Emergency Response

There is always the potential that an emergency situation could occur. These "emergency situations" include, but are not limited to, the following:

- Fire
- Unplanned loss of power
- Unplanned environmental release
- Extreme/dangerous weather (i.e., tornado, severe electrical storm, blizzard)
- Natural disasters (i.e., earthquake, flood)
- Acts of violence and/or vandalism

In the case of an on-site emergency, specific procedures will be followed to ensure the safety of on-site personnel, others who may be present in the work area, and/or the general public in vicinity of the work area. An ERP has been prepared for this remediation and is presented in **Appendix E**. All on-site personnel associated with TCH operations are required to review the site-specific ERP, be familiar with the site-specific emergency response procedures, and be able to carry out those procedures in the case of an emergency. If any on-site personnel feel that they cannot carry out any emergency response procedure, the SHSO and/or PM should be notified so that arrangements can be made to meet the requirements of the site-specific ERP.

4.0 PPE PROGRAM

Personnel will wear Level D PPE when on-site, which consists of the following:

- Work clothing as dictated by the weather
- Safety (steel-toe or equivalent) shoes or boots
- Safety glasses
- Hard hat (as needed)
- Nitrile (or equivalent) gloves (use when handling or contact may occur with contaminated soils or similar materials)
- Work gloves (as needed)
- Hearing protection (as needed)
- Hi-Vis vest or equivalent (as needed)

Level D PPE provides no respiratory protection and minimal skin protection. Level D PPE should be used when the concentrations of chemicals in the workplace atmosphere contains less than the regulatory limit and work functions preclude the potential for unexpected inhalation of, or other contact with, hazardous levels of any chemical. For Level D PPE, the workplace atmosphere must contain at least 19.5 percent oxygen.

Personnel will be trained on the proper use and limitations of PPE described within this section prior to use on-site. Any personnel using a respirator will be trained in accordance with TRS respiratory training program (**Appendix C**) and have current fit-test documentation (completed within the past year).

4.1. Hearing Protection and Noise Control

The TRS hearing conservation program is based upon limiting the exposure of on-site personnel and visitors to excess noise. All on-site personnel and visitors will be provided with protection against the effects of hazardous noise exposure. Protection will include earplugs, earmuffs, or a combination of both. On-site personnel and visitors will be required to use hearing protection whenever sound-pressure levels exceed 85 decibel (dB) steady-state expressed as a time weighted average (TWA). It will be assumed that this sound pressure level is not exceeded if two people can engage in conversation using normal voices within three feet from the noise source.

4.2. Eye Protection

Airborne particulates, flying debris, and chemical exposure can cause injury to eyes. Safety glasses will be worn during all phases of work of the remediation. All safety glasses used will meet ANSI Z87.1-2010 standards. When work conditions warrant and as determined by the TRS SHSO, full-face shields, goggles, or chemical goggles may be worn.

4.3. High Visibility Clothing

Hi-Vis outer garments will be required for any activities using heavy equipment including bobcat/skid-steers, excavators, loaders, cranes, forklifts, or similar machinery. Hi-Vis outer garments will consist of, at a minimum, a Hi-Vis vest. Hi-Vis shirts and/or jackets are permissible as long as they are the outermost layer of clothing. Hi-Vis garments should be clean as to promote visibility and meet ANSI requirements for "Performance Class 2/Type R" standards as defined in ANSI standard 107-2015.

4.4. Dermal Protection

Protective clothing, such as Tyvek® suits and nitrile gloves will be worn when dermal exposure to hazards warrants, as determined by the SHSO. Tyvek® suits are not required for the TCH project, but on-site personnel may elect to wear them during intrusive, subsurface activities such as drilling. Clothing must be maintained and stored properly to prevent damage or malfunction due to exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures, and impact. Tyvek® suits will not be reused; they will be disposed of at the end of each workday at minimum or whenever necessary. Any PPE that may have come into contact with NAPL or other contaminants will be segregated and stored in a sealed container with appropriate labeling prior to disposal.

4.5. Respiratory Protection

The need for respiratory protection is not anticipated during TCH construction, operation, and demobilization. However, due to the nature of TCH, there is always the potential for respiratory hazards. As such, all on-site personnel performing tasks with the potential for respiratory hazards will have current respirator fit testing and have respiratory protection available on-site. The SHSO, PM, or Site Manager will review daily tasks planned and provide direction on respiratory PPE required for those tasks during daily tailgate meetings. If respirator use is warranted, half-face or full-face respirators are required for all personnel working at the project site.

Level C PPE provides respiratory protection when atmospheric conditions exceed the action level for airborne contaminants (see **Section 5.0**). Level C PPE should be worn when the types of air contaminants have been identified, concentrations measured, and a respirator filter cartridge is available that can remove the COCs. Level C PPE should not be used if atmospheric concentrations of any chemical exceed immediately dangerous to life and health (IDLH) levels or if the workplace atmosphere contains less than 19.5 percent oxygen (see **Table 4** for IDLH values for expected COCs). While not anticipated, Level C PPE will include a half-face or full-face air purified respirator with P100/OV cartridges at a minimum. During drilling and excavation operations, all staff associated with these tasks are required to have on-site an air-purifying respirator and a combination high efficiency particulate air (HEPA) and volatile organic filter cartridges (P100/OV).

Level B and Level A respiratory protection should be used when concentrations of chemicals in the workplace atmosphere are above the regulatory limit. If this situation arises, work will cease until a

site- and task-specific addendum to this HASP is prepared which will include appropriate training and equipment required.

4.5.1. Maintenance and Storage

All respirators will be inspected prior to use. The inspection will include a check of respirator function, tightness of connections, and the condition of the various parts including, the face piece, head straps, valves, connecting tube, and cartridges, canisters, or filters and a check of elastomeric parts for pliability and signs of deterioration.

The respirators will be cleaned and disinfected at the following intervals:

- Respirators issued for the exclusive use of an employee will be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
- Respirators issued to more than one employee will be cleaned and disinfected before being worn by different individuals.
- Respirators maintained for emergency use will be cleaned and disinfected after each use.
- All respirators will be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they will be packed or stored to prevent deformation of the face piece and exhalation valve.

4.6. Construction Safety

Steel-toed shoes/boots or safety shoes/boots conforming to ANSI Z41.1-1991 and American Society for Testing and Materials (ASTM) F 2412-05 and F2413-05 with chemical resistant soles will be worn during all phases of work on-site. A hard hat will be worn during any phase of on-site work when overhead obstructions exist, while acting as a traffic spotter, or during the use of heavy equipment. A Hi-Vis safety vest or an outermost layer of safety/reflective coloring will be worn when heavy equipment is present and in operation, during drilling and excavation operations, during any task where traffic control is in effect, and as site-specific conditions warrant or as directed by the SHSO (or their designee). Protective work gloves are required for all phases of work at the project site.

5.0 AIR MONITORING PROGRAM

The work space air monitoring program will be implemented by Ramboll. Their plan can be found in Appendix G.

6.0 TRS TCH-SPECIFIC SAFETY PROCEDURES

All TRS personnel, TRS subcontractors, or others participating in on-site activities with TRS must be familiar with standard operating safety procedures and any additional instructions and information contained in this HASP, HASP appendices, and applicable TRS SOPs. Copies of applicable TRS SOPs will be maintained on file on-site.

6.1. TCH System Operations

TCH system operations will be conducted in accordance with TRS internal SOPs and equipment operating standards. Only trained and qualified TRS personnel will operate TRS TCH equipment.

6.1.1. TCH Start-Up

Only qualified, trained TRS personnel will conduct TCH start-up activities. Start-up and initial unattended operations of the TCH control system are performed only when the site-specific start-up checklist has been completed and signed off by authorized TRS operations personnel.

6.1.2. TCH Emergency System Shut Down

During TCH operations, if an emergency condition should arise; all personnel have the authority to depress the emergency stop (E-stop) button on the TCH control system which will de-energize the TCH heaters in the field. An E-stop button is located near the main panel of the TCH control system. Additional E-stop buttons will be installed at the facility and located near the entrance to the equipment compound. The procedure for emergency shutdown is as follows:

- Press the emergency stop button.
- Access the TCH control system main panel, open the primary output breaker, attach a "Danger/Do Not Operate" tag on the breaker, and lock out the primary output breaker in accordance with TRS SOP 1.1 for LOTO.
- Notify the TRS operator, TRS PM, and/or TRS SHSO of the emergency shutdown at the first available opportunity.
- Once the emergency condition has been rectified and the TRS PM (or their designee) has provided approval to re-apply power to the TCH heaters, the primary output breaker can be re-energized in accordance with TRS SOP 1.1 for LOTO.
- Notify the TRS operator to re-start the TCH system.

6.2. TCH Operations Work Zones

Due to the hazards that exist on-site during TCH operations, TRS will establish a TCH restricted zone (RZ). The TCH RZ is an area established to permit access to only authorized personnel who have been properly trained or who are escorted by properly trained personnel and have signed the TCH Restricted Zone Acknowledgement Form.

The TCH RZ will have a clearly defined boundary that restricts access but may consist of movable boundaries (such as temporary chain-link fencing or snow fencing) during operations. Proper signage delineating the area shall be posted.

In the event a hazardous condition exists within the TCH treatment area that cannot be eliminated or controlled through administrative or engineering control methods, a TCH EZ will be established to prevent access by all personnel while power is applied to the subsurface. TRS will maintain sole control of any EZ established on-site. The EZ will have a locked access point with immovable boundaries and shall only be entered following the completion of LOTO procedures in accordance with TRS SOP 1-2 for LOTO. Approval by the TRS Vice President (VP) of Operations or TRS SQM is required prior to access a TCH EZ with the TCH heaters activated. Proper signage delineating the area shall be posted. EZs on-site include live electrical panels and transformer compartments. Restricted zones will include the heater well field, equipment compound, and all areas within the fence.

6.3. Lockout/Tagout

Safe work practices will be used to safeguard employees from injury while they are working on or near exposed electrical conductors or circuit paths that are, or can become, energized. The specific safety-related work practice shall be consistent with the nature of and extent of the associated potential energy hazards. Prior to performing work in the restricted zone that could expose personnel to electrical current, trained personnel must lockout and tagout the TCH control system. Only TRS staff who have been trained in LOTO procedures in accordance with TRS SOP 1.1 Lockout/Tagout may perform LOTO procedures. In addition, TRS staff must sign the SOP 1.1 Training Acknowledgement Form following their training and confirmation of competency by their trainer. All TRS personnel performing LOTO on-site must have a current certification and training in NFPA 70E.

Unless it can be demonstrated that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations for specific tasking, exposed energized electrical conductors or circuit paths to which an employee might be exposed will be put into an electrically safe work condition before an employee works on or near them. Workers in the vicinity of exposed and potentially live electrical conductors will follow procedures defined in NFPA 70E to ensure personal safety.

Note: *Only authorized TRS personnel experienced and trained to operate or perform maintenance on the ISTR remediation equipment or system support components are allowed to conduct the LOTO procedures on TRS equipment as described in TRS SOP 1.1 Lockout/Tagout.*

7.0 DECONTAMINATION

TRS employees and subcontractors shall implement work practices that minimize contact with hazardous substances (e.g., do not walk through areas of obvious contamination; do not directly touch potentially hazardous substances). All TRS' on-site work will be performed in modified Level D PPE. Should changes in on-site conditions cause an upgraded level of personal protection, all impacted workers will be informed of the necessary equipment and decontamination requirements.

7.1. Personal Decontamination Procedures

Personnel, clothing, equipment, and samples leaving the contaminated area of the work area must be decontaminated to remove harmful chemicals or infectious organisms that may have adhered to them. While in modified Level D PPE, any disposable PPE, including nitrile gloves and Tyvek® suits will be disposed in a designated and appropriate labeled drum prior to disposal.

Potable water will be provided on-site. Workers will wash hands and face before breaks, lunch, and before leaving the job site. Water, soap, and clean towels will be provided. Boots and hard hats will be washed with detergent and rinsed with potable water as needed.

If an upgrade to Level C personal equipment occurs, all non-disposable protective equipment will be cleaned in a specified contaminant reduction zone prior to leaving the work area either for reuse or as trash. If needed, respirators will be dismantled, washed, and disinfected after each use or as needed. Disposable Level C PPE (respirator cartridges, clothing, gloves, etc.) will be disposed of in a labeled drum and analyzed prior to disposal.

Personnel will be trained in decontamination procedures to minimize contact with possible contaminants and maximize worker protection. These procedures will be enforced throughout TCH operations.

7.2. Vehicle and Equipment Decontamination

A containment berm or decontamination pad will be constructed at a location that the TRS SHSO, TRS PM, and the Ramboll representative(s) deem is most adequate to perform decontamination for equipment and tools. Decontamination will be performed on an as-needed basis. It is assumed that all equipment in contact with subsurface contamination will require on-site decontamination. If necessary, equipment and sampling tools will be decontaminated by scrubbing with detergent water using a brush, followed by rinsing with water.

Drilling and excavation equipment will be decontaminated by pressure washer prior to arrival at the project site. TRS will inspect all drilling and excavation equipment arriving on-site and may require additional decontamination of equipment if deemed necessary prior to using the equipment on-site. Equipment that has touched soil below grade will be decontaminated by pressure washer prior to leaving the work area. The drilling and/or excavation subcontractor will establish a decontamination area with a containment unit to collect water and debris from decontamination. Any decontamination water that collects in the containment area will be pumped to DOT-approved 55-gallon drums for temporary storage prior to disposal. All waste drums will be properly labeled in accordance with applicable local, state, and federal requirements. Decontamination fluids will be handled and contained in accordance with site-specific waste management plans.

7.3. Decontamination during Medical Emergencies

If emergency life-saving first aid and/or medical treatment are required, decontamination procedures may be omitted at the professional emergency responder's direction. The appropriate on-site personnel and/or professional emergency responder will accompany contaminated victims to the medical facility to advise them on matters involving decontamination. Refer to the "Health and Safety Plan Summary" at the beginning of this document and/or **Section 13.2** for information on local emergency care facilities.

Life-saving care will be instituted immediately without considering decontamination. The outer garments can be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, the individual can be wrapped in plastic to help prevent contaminating medical personnel. No attempt need be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material, which could also cause severe injury or loss of life. If it is at all possible, it is best to have a professional emergency responder make the judgment and perform the above-mentioned procedures. For minor medical (non-life threatening) illnesses or injuries, the normal decontamination procedures will be followed.

For inhalation exposure cases, treatment can only be performed by a qualified physician.

If the contaminant is on the skin or in the eyes, rinse/flush the affected area with water for 15 minutes. Portable 15-minute eyewash station containing potable water or eyewash solution will be maintained on-site during activities using or have potential exposure to corrosive materials. At all times, a minimum of six 32-ounce eye-wash bottles will be on-site for emergency use.

8.0 HAZARD ASSESSMENT

The SHSO, or a designee, will prepare a chemical inventory list of chemicals brought on-site (See **Appendix D**). If new chemicals or hazardous substances are brought on-site, employees must inform the SHSO. The SHSO will be responsible for updating the project's chemical inventory as needed and maintaining the SDS compendium for the project. SDSs will be added or removed from the compendium as materials are brought onto or no longer exist on-site. Any on-site personnel potentially exposed to a substance will be advised of information contained in the SDS for that substance.

Each container entering the workplace will be checked for appropriate labeling, if applicable. Container labels will include the following:

- Identity of the hazardous chemical
- Appropriate hazard warning
- Name and address of the chemical manufacturer

Containers which hazardous chemicals are transferred into must be labeled, tagged, or marked with the identity of the hazardous chemical(s) and appropriate hazard warnings. TRS uses routine audits and inspections to evaluate and mitigate on-site hazards to the extent practical.

8.1. Day 1 Health and Safety Inspection

Prior to the first day of field activities, the TRS PM or SHSO will conduct a "Day 1" health and safety readiness inspection to ensure all the required PPE, first aid kit(s), eye-wash bottle(s)/station, and other essential health and safety items are on-site. If items are shown as incomplete upon inspection, replacement items will be expedited to the project site at a prioritized rate. A copy of the "Day-1 Readiness Health and Safety Checklist" is provided in **Appendix A**.

8.2. SHSO Inspections

General safety inspections will be conducted monthly, unannounced, at times selected by the SHSO or his designee to ensure compliance with the HASP. The purpose of these general inspections is to ensure that project health and safety procedures are being implemented in accordance with the HASP and to identify any issues which may require further evaluation, discussion, or actions. The results of these inspections will be documented in writing and submitted to the TRS SQM and also discussed at the next Daily Tailgate Health and Safety Meeting.

In addition to the bi-weekly inspection, the SHSO will complete a monthly inspection to review and update all health and safety documentation, including the compendium of SDSs. The monthly compliance inspection will also include and inspection all health and safety equipment and emergency response materials.

8.3. Corporate Health and Safety Audits

Periodic inspections to identify and evaluate workplace hazards shall also be performed by the Corporate SQM or his designee. Inspections may occur:

- When mobilization to a new project site first occurs
- Every other week by the SHSO or his designee

- When new substances, processes, procedures or equipment that present potential new hazards are introduced into the workplace
- When new, previously unidentified hazards are recognized
- When occupational injuries, illnesses, spills, and near misses occur.
- Whenever workplace conditions warrant an inspection

8.4. Hazard Correction

Unsafe or unhealthy work conditions, practices or procedures at TRS work facilities shall be corrected in a timely manner based on the severity of the hazards, and according to the following procedures:

- When observed or discovered.
- When an imminent hazard exists, which cannot be immediately abated without endangering employee(s) and/or property, TRS will remove all exposed workers from the area except those necessary to correct the existing condition. Workers necessary to correct the hazardous condition shall be provided with the necessary protection.
- All such actions taken and dates they are completed shall be documented on Daily Tailgate Forms or the final incident report.

9.0 MEETINGS AND INSPECTIONS

9.1. Pre-Construction Safety Meeting

The TRS PM or his designee will conduct a pre-construction safety meeting before any work begins at the project location and on the first day of mobilization in the field of new personnel. Every person working in the field, including TRS employees and subcontractors, must attend a pre-construction safety meeting. Meeting participants will review the HASP and the site-specific safety concerns. At a minimum, the following topics will be covered in the preconstruction safety meeting:

- Team members and responsibilities, including SHSO
- Location of on-site first aid equipment and spill containment equipment
- Route to local hospital/occupational medical facility and contact information for emergency medical services
- Site security/visitor control
- COCs and signs of exposure
- Physical and biological hazards
- Proper PPE requirements including review of respiratory protection, air monitoring plan, and associated action levels
- Overhead power lines and other overhead hazards
- Areas and tasks requiring fall protection
- Safe operation of vehicles and heavy equipment
- Fire protection, prevention, and location of extinguishers
- Lockout/Tagout requirements
- Permit requirements (e.g. hot work and confined spaces)

- Emergency response procedures (ERP – **Appendix E**) and project muster point(s)

All personnel will document their understanding of this HASP and the pre-construction safety meeting by signing the HASP Acknowledgement Form included in **Appendix A**.

9.2. Pre-Operations Safety Meeting

Prior to beginning TCH operations on-site, the TRS PM or his designee will hold a pre-operations safety meeting. At a minimum, the following topics will be covered before personnel are permitted to work within the TCH RZ during the system operational phase of work:

- Proper LOTO requirements to enter the electrode field and a complete review of the TRS SOP 1.1 for LOTO (all personnel will acknowledge SOP training by signing the SOP training acknowledgement form).
- Project protocols with respect to site-specific restriction zones and exclusion zones.
- Proper PPE requirements including review of respiratory protection, air monitoring plan, and associated action levels.
- Site-specific training regarding potential hazards with TCH equipment. Training should include (but not be limited to) electrical hazards, hot surfaces, pinch points, slip/trip/fall hazards, confined spaces, and contaminants of concern.
- Site-specific and task-specific training regarding on-site sampling requirements. Training should include the potential hazards of sampling and review of appropriate TRS SOPs 3.1 and/or 3.2 for hot groundwater and hot soil sampling, respectively.
- Training on locations and function of the E-stops. The E-stop will deactivate the TCH heaters but will not deactivate vapor recovery or treatment equipment.
- On-site training for Emergency Response and the possible scenarios (see ERP **Appendix E**).
- Confirmation that all on-site personnel have completed site-specific reading assignments as outlined by the TRS PM, SHSO, or TRS SQM.

All personnel will document their understanding of topics addressed in the pre-operations safety meeting by signing the TCH Restricted Zone Acknowledgement Form included in **Appendix A**.

9.3. Daily Tailgate Health and Safety Meetings

A daily tailgate meeting will be held each day when personnel are on-site during all phases of the TCH project. The PM, the SHSO, or a delegate of the SHSO will conduct these meetings. All on-site personnel will attend. The tailgate meetings will be conducted on-site, prior to the commencement of the daily activities. The agenda of the meeting may vary, but, at a minimum, it will cover the activities planned for the day, including operations which may occur in other areas of the project site that could potentially impact the planned work (e.g., site-specific equipment or materials deliveries, expected visitors, planned inspections), an overview of the known hazards, and methods to be used to mitigate the hazards. Daily tailgate meetings will include the review of applicable TRS SOPs and AHAs for work to be performed. Any near-miss events or incidents from previous work will be discussed as lessons learned. The SHSO will also discuss any recently completed inspections and inspection findings. The daily tailgate meeting form (**Appendix A**) will be completed and maintained on file on-site. As needed, the Site Supervisor or SHSO may conduct additional tailgate meetings during a given day if changes in on-site conditions, changes in work tasks, or recognition of hazards (near-miss events or incidents) warrant additional review with on-site staff.

9.4. General Work Area Safety Inspections

General work area safety inspections will be conducted weekly, unannounced, at times selected by the SHSO or his designee to ensure compliance with the HASP. The purpose of these general inspections is to ensure that project health and safety procedures are being implemented in accordance with the project safety plan, and to identify any issues which may require further evaluation, discussion or actions. The results of these inspections will be discussed at the next Daily Tailgate Health and Safety Meeting as discussed in **Section 9.3**.

9.5. Safe Behavior Observations

Safe Behavior Observations (SBOs) are a key component of the TRS BBS program. SBOs will be conducted either by the SHSO or designated TRS personnel, using the form contained in **Appendix A**. The goals of conducting an SBO are to:

- Reinforce safe work practices and behaviors
- Identify and improve at-risk practices and acts
- Improve task procedures, conditions and controls
- Ensure that the necessary tools and supplies are available
- Facilitate collaborative feedback

The SBO evaluations will provide real-time feedback on unsafe actions and conditions on a regular basis to the work crews. Following the observation and feedback session, the SBO form will be returned to the SHSO for evaluation and record keeping. Copies of all SBO forms will also be submitted to the SQM for review. These evaluations will be conducted as on-site conditions and activities warrant. SBOs will not be completed when only one person is present on-site.

10.0 ROLES, RESPONSIBILITIES, AND AUTHORITY

TRS has established an organizational structure for providing technical direction and administrative control to accomplish safety and quality-related goals on this project. All project personnel are responsible to make health and safety the top priority on-site each day. The key personnel for the project are identified below:

- Senior Project Manager: Chris Thomas
- TRS Project Manager: Sean Fournier
- TRS Site Safety and Health Officer: Jeff Riffe
- TRS Safety & Quality Manager: Greg Knight

Copies of the HASP, appendices, and applicable SOPs will be provided to client staff and subcontractors who will have personnel working on-site. At the time of mobilization to the project site, the SHSO will confirm that they understand the overall safety and health objectives for the project and have been trained and are familiar with the requirements of this HASP. All client staff and subcontractors will document HASP training by signing the HASP Acknowledgement Form (**Appendix A).** The SHSO will have the authority to ensure all personnel on-site follow the health and safety procedures set forth in the HASP and to dismiss any personnel who does not comply with this HASP and/or acts in an unsafe manner.

10.1. Corporate Safety & Quality Manager

The TRS Corporate SQM, Greg Knight, is responsible for developing and implementing the provisions of the TRS CSP. The SQM will support each project team to assist with development of the site-specific HASP for every project.

10.2. Project Manager

The TRS PM has overall responsibility and authority to direct technical, management, and contractual matters for those portions of the project under the supervision of TRS. The PM is required to effectively communicate on-site risks and the requirements of the HASP to TRS' employees, TRS' subcontractors, and those on-site personnel being supervised by TRS while they are performing project-related activities. The TRS PM has the following additional responsibilities:

- Promote and maintain that the personal safety of all staff working at the project location is the top priority every day on every task or activity
- Serve as the primary contact with the client or the client's representative
- Establish appropriate health and safety procedures for TRS' on-site activities
- Ensure that project staff are properly trained
- Enforce health and safety requirements, and determine disciplinary actions for violations of the plan
- Ensure that necessary permits for TRS' activities have been obtained prior to starting field work
- Ensure that required field personnel attend health and safety briefings and tailgate meetings
- Review and update the HASP
- Participating in incident investigations
- Stop work in the case of unsafe acts, work practices, or otherwise hazardous on-site conditions

10.3. Site Health and Safety Officer

The TRS SHSO is responsible for documenting that the designated procedures of this HASP are implemented in the field by TRS employees, TRS subcontractors, and others participating with TRS in the completion of project tasks under the management of TRS. In some cases, the SHSO role may be filled by the TRS PM.

The TRS SHSO will serve as the on-site point of contact for all health and safety matters related to work being performed or supervised by, TRS. The TRS SHSO will provide technical information regarding health and safety to on-site personnel. The TRS SHSO will also oversee on-site activities with respect to health and safety issues and will stop work if conditions are determined to be detrimental to on-site personnel, equipment/property, or the environment.

The TRS SHSO has the following responsibilities for on-site activities under the direction or supervision of TRS:

- Promote and maintain that the personal safety of all staff working at the project location is the top priority every day on every task or activity

- Ensure that all known tasks assigned to TRS, the hazards associated with those tasks, and protective controls required for those tasks have been identified
- Ensure that only personnel qualified in accordance with applicable health and safety requirements are allowed to perform field work
- Ensure that only qualified individuals are allowed access to on-site locations or operations where potential hazards exist
- Ensure that proper security and control of RZs and EZs on-site are maintained
- Conduct documented inspections of TRS' work activities
- Stop work and remove personnel from the field if personnel, equipment, property, or the environment are jeopardized by unsafe work activities or otherwise hazardous on-site conditions
- Provide site-specific training to new employees and visitors including required "Right to Know" information (see **Section 8.0** Hazard Communication)
- Conduct and/or participate in daily tailgate health and safety meetings
- Ensure that employees know the location of safety equipment, such as fire extinguishers, eye-wash stations, and first aid kits, and that this equipment is kept current
- Perform scheduled inspections of health and safety equipment including, but not limited to, fire extinguishers, first aid kits, bloodborne pathogen response kits, fall protection equipment, automated external defibrillators (AEDs), eye wash equipment, and emergency shower (if equipped)
- Ensure that proper hazard, right-to-know, and other safety and labor information (local, state, and federal) are posted in a prominent place on-site
- Ensure that all operations are conducted in a manner to mitigate adverse environmental impacts
- Ensure that work practices promote the TRS BBS program including the performance of SBOs, recognition and correction of unsafe behaviors, and reporting of near-miss and incident events
- Establish and maintain the hazard communications program, including SDS and training materials
- Maintain on-site binders for TRS AHAs and SOPs
- Maintain health and safety related record keeping including, but not limited to, daily tailgate meetings, HASP review and acknowledgement, safety related training (SOPs and AHAs), SDS and on-site chemical inventory, and any client-specific records required
- Maintain health and safety related data records including, but not limited to, PID monitoring logs, dust monitoring logs, and voltage testing
- Evaluate work areas for any hazards not identified in the HASP and initiate safety measures to protect personnel, including appropriate revisions to health and safety documents
- Immediately report near-miss events and incidents in accordance with this HASP and TRS procedures

- Coordinate with off-site emergency responders and medical service organizations to establish required emergency services and verify that emergency phone numbers and addresses are current and accurate

10.4. Field Personnel

Field personnel are responsible for performing work in a safe and healthful manner. They are responsible for abiding by the requirements of the HASP, and for fulfilling and maintaining their individual training and medical surveillance programs. If there are concerns that implementation of work orders or health and safety requirements would unreasonably compromise the safety or health of an individual or the environment, such concerns should be brought to the attention of an immediate supervisor or the SHSO. Field personnel are responsible for the following:

- Perform work to maintain personal safety as the top priority
- Abide by the requirements of this HASP
- Exercise "stop work" if unsafe acts or hazardous on-site conditions are recognized that could lead to personal injury, equipment or property damage, or unplanned environmental release(s)
- Take all reasonable precautions to prevent injury to themselves and to their fellow employees
- Being alert to potentially hazardous situations
- Employ safety tools provided such as AHAs, SOPs, and SDSs to mitigate hazards and promote worker safety
- Perform only those tasks for which they have been trained and believe they can do safely, and immediately report any accidents, near misses, and/or unsafe conditions to the SHSO
- Notify the SHSO of any special medical conditions (i.e., allergies, contact lenses, pregnancy, diabetes, etc.) and, if necessary, ensure that all on-site personnel are aware of the condition
- Prevent spillage to the extent possible. If a spill occurs, contain the spillage and clean-up immediately using safe clean-up measures as directed by the SHSO
- Practice good housekeeping at all times
- Immediately report all injuries, accidents, environmental releases, and near-miss events

10.5. Subcontractors

Subcontractors are responsible for establishing, implementing, and maintaining a health and safety program for their employees. Subcontractors are responsible for performing work activities in a safe and healthful manner in accordance with both the subcontractor's health and safety program and this HASP. In the event that a subcontractor's health and safety program conflict or differs from this HASP, the SHSO and PM will review the program components with the subcontractor's safety representative and develop the best approach to project tasking.

10.6. Stop Work Orders

When any employee observes a condition of "imminent danger", unsafe work or actions, or hazardous on-site conditions, that employee can exercise Stop Work Authority. Imminent danger

means a condition or hazard that would reasonably be expected to cause death or serious harm to workers or members of the public, may result in equipment or property damage, or may result in an unplanned environmental release.

Examples of unsafe work conditions can include, but not inclusive to:

- Operation of drill rig too close to overhead power lines
- Air monitoring detection at or above established action levels, OSHA 8-hr TWA, or IDLH limits
- Unsafe operation of heavy equipment
- Failure of workers to wear proper safety equipment, such as required PPE or fall protection equipment

Should an employee exercise Stop Work Authority, the TRS SHSO will be notified immediately. Further, TRS interprets "stop work authority" a step further where every TRS staff, TRS subcontractor, or other personnel working on-site have a ***"Stop Work Obligation"*** if they recognize any act or condition that could lead to an incident.

11.0 COMMUNICATION

TRS' policy is to maintain open communication between management and staff on all matters pertaining to safety. The following is TRS' system of communication, designed to facilitate a continuous flow of two-way (management, supervision, and employees) safety and health information in a form that is readily understandable to and between all affected on-site personnel:

- New worker orientation, including a discussion of site-specific safety and health policies and procedures
- Site-specific Health and Safety Plans
- TRS CSP
- SOPs
- AHAs
- Workplace-specific safety and health training including Arc Flash training in accordance with NFPA 70E and HAZWOPER training in accordance with 29 CFR Part 1910.120.
- The following on-site safety meetings are conducted by the TRS PM or his/her designee:
- Pre-construction safety meeting. Before any work begins on-site and on the first day of mobilization in the field.
- Pre-operations safety meeting. Prior to beginning TCH operations.
- A daily tailgate meeting. Each day when TRS personnel are on-site during all phases of the TCH project.
- TRS has established a Health and Safety Committee to review health and safety procedures, implementation, documentation, and tracking. Ata a minimum, the Health and Safety Committee shall consist of the VP of Operations, the TRS SQM, and an additional staff member. At a minimum, this committee meets every other month to review the status of health and safety across the company, identify areas of improvement, and set goals for the program
- Posted and distributed safety information

- Personnel may report health and safety concerns to their supervisor, the SHSO, or directly to the SQM. Concerns may also be documented in writing on the SHSO status report or monthly checklist
- SBOs
- Follow-through by supervision to ensure effectiveness

It is every TRS employees' responsibility to work safely in every task they perform. Every TRS employee has personal responsibility to practice BBS principles to improve site and worker safety and share ideas for health and safety programs across the company.

12.0 TRAINING

Due to the nature of the work to be performed on-site, special training will be required based on the activity performed. Training records for all on-site personnel will be maintained on-site by the SHSO and available upon request.

12.1. General Hazardous Waste Operations Training

To protect on-site personnel from exposure to chemical hazards, it is possible that exclusion zones will be established to contain contaminated materials and will be in place during the duration of each phase of the project. Before Site personnel or visitors may enter an EZ or complete subsurface invasive work activities or perform tasking which has the potential for contact with hazardous materials, they will be required to have successfully completed the following training:

- Initial 40 hours of HAZWOPER training as required under 29 CFR 1910.120
- Eight hours of HAZWOPER refresher training annually as required by 29 CFR 1910.120
- Three days of actual field experience under the direct supervision of a trained, experienced supervisor

Visitors and Site personnel, such as surveyors and electricians, who must enter the Site but will not be entering EZs or performing any subsurface invasive work will not require HAZWOPER training in accordance with 29 CFR 1910.120.

Before a Site worker or visitor may enter an EZ, their employer must provide the SHSO with a certification showing that the worker or visitor has completed their HAZWOPER initial and refresher training. These certifications will be maintained in an on-site file and be available for review.

The SHSO understands TRS' safety and health program and will be trained in TRS' PPE, TCH operations, LOTO procedures, spill containment, hot media sampling procedures, and health hazard monitoring procedures and techniques.

12.2. Site-Specific Training

The information and training employees receive must be tailored to the types of chemical and/or physical hazards and exposures they may encounter at the Site. The training program is designed for both new and experienced employees. Hazard communication training will be provided for employees before and/or immediately when they arrive on-site. Additional training will be provided when a new chemical or hazardous material is brought into the workplace. The following

information will be given to employees with a potential for exposure and to all new site workers or whenever TRS becomes aware of a new or previously unrecognized hazard.

- Explanation of the TRS CSP and this Site-specific HASP
- Measures for reporting any unsafe conditions, work practices, injuries and when additional instruction is needed
- Physical hazards at the Site and methods for hazard mitigation
- RZs and EZs at the Site
- Chemicals present at the Site (in use and stored)
- Availability of toilet, hand-washing, and drinking water facilities
- Hazardous wastes stored on site and the location of these materials
- Reported soil and groundwater contamination compounds, associated hazards, signs and symptoms of exposure, and hazard mitigation measures
- Physical and health effects of the hazardous chemicals
- Methods and observation techniques used to determine the presence or release of hazardous chemicals
- Methods regarding minimizing or prevention of exposure to these hazardous chemicals through the use of engineering and administrative controls and PPE
- Proper housekeeping, such as keeping stairways and isles clear, work areas neat and orderly, and promptly cleaning up spills
- Prohibiting horseplay, scuffling, or other acts that adversely influence safety
- Prevention of musculoskeletal disorders, including proper lifting techniques.
- Air monitoring action levels associated with Site COCs
- Steps the project team has taken to lessen or prevent exposure to COCs
- Emergency procedures to follow if an individual is exposed to COCs
- Directions to and contact information for local emergency medical services
- Site emergency contact information (see ERP **Appendix E**)
- Site-specific emergency response procedures as defined by the ERP (**Appendix E**)
- How to read labels and review SDS documents to obtain appropriate hazardous information
- Location of SDS files and location of hazardous chemical lists

12.3. Electrical Safety Training

Prior to working on-site during TRS TCH remediation operations, TRS personnel who intend to enter the restricted zone must complete the following electrical safety requirements:

- Read and understand the TRS Electrical Safety Policy
- Read and understand the Site-specific Arc Flash and Short Circuit Assessment (**Appendix F**)
- Read and understand the TRS Working Alone guidance (see **Section 3.1.2**);
- Complete Electrical Safety NFPA 70E Arc Flash Training

- Complete TRS training on LOTO procedures as described in TRS SOP 1.1 Lockout/Tagout, including training on emergency shutdown procedures
- Complete the Site-specific TRS electrical restricted zone training and sign the acknowledgement form included in **Appendix A**

No TRS personnel shall work within medium voltage panels (greater than 600 volts) at any time.

12.4. Crane and Lift Truck Operator Training

Only appropriately trained heavy equipment operators may operate heavy equipment, this includes lift trucks. Specific to tasking anticipated at the Site, only operators trained and certified in accordance with 29 CFR 1926.1427 shall operate a crane. Only personnel trained in accordance with 1910.178 will operate lift trucks. Crane and lift truck operators must present copies of training documentation to the TRS SHSO prior to commencing any lift.

12.5. Respiratory Training

Any personnel using a respirator will be trained and fit tested in accordance with TRS respiratory training program included as **Appendix C** of this document. Current fit-testing will be less than one-year old.

12.6. Competent Person Training

Certain activities or safety procedures at a construction site require design, inspection or supervision by a competent person. The OSHA Construction Standard defines a competent person as someone who:

- is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees
- has authorization to take prompt corrective measures to eliminate any issue

Unless otherwise noted in the Daily Tailgate Health and Safety Meeting, the SHSO will serve as the Competent/Qualified Person to complete the following health and safety requirements:

- General safety and health
- Safety training
- Fire protection and prevention
- PPE
- Noise exposure
- Gases, vapors, dusts, and mists (air monitoring)
- Hazard communication
- HAZWOPER
- Waste disposal
- General electrical
- LOTO
- Work at heights, fall protection, and ladder safety
- Motor vehicle safety

During the Daily Tailgate Health and Safety Meeting, TRS and on-site subcontractors will identify the Site-specific competent persons required to complete daily tasking. Competent persons are required for the following anticipated Site activities:

- Rigging (TRS staff will not conduct rigging of any equipment)
- Electrical
- Aerial lifts
- Cranes or hoists
- Powered industrial trucks (forklifts)
- Excavations
- First aid and medical
- Signaling

12.7. Other Training

Personnel involved in the transportation of hazardous material will be trained in accordance with 49 CFR 172, Subpart H.

All personnel operating electric and or pneumatic tools will receive training on their use and safe operation.

12.8. Medical Surveillance

The expected duration of the project is estimated to be nine to twelve months. Exclusion zones will be established to contain contaminated materials and to protect Site personnel and visitors from exposure to chemical hazards. It is possible that these zones will be in place during the duration of the project. Personnel working on this project who enter such exclusion zones will be required to participate in a medical monitoring program that meets the requirements of 29 CFR 1910.

12.8.1. Medical Examination Requirements

OSHA suggests that a baseline medical monitoring program contain the components listed below.

- Medical History/Physical
- Audiometry
- Respirometry
- Vision by Machine
- Urinalysis
- Blood Chemistries

The employer of each on-site personnel or visitor who enters an EZ will be required to provide the SHSO with a signed letter stating that the employee currently participates in a medical monitoring plan that meets the requirements of 29 CFR 1910 and has passed a respirator fit test within the last 12 months. The employer will also provide the SHSO with a letter or certificate signed by physician or other licensed healthcare professional stating that the employee is physically fit to perform the work duties assigned to him or her and has medical clearance to use a respirator. These documents must be provided to the SHSO and filed for review before the employee will be allowed to enter an EZ.

12.8.2. Exposure Monitoring

Any person exposed to high levels of hazardous substances will be required to undergo a repeat medical surveillance examination at, or if necessary, before the conclusion of the project. Such an examination will help determine the medical implications of the exposure. The type of surveillance examination will be determined by the SHSO and TRS SQM based on the exposure. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work on-site.

12.8.3. Post-Accident/Incident Testing

In the event of an accident or incident on-site where there is personal injury and/or property damage in excess of $1,500.00, TRS may require drug and/or alcohol screening for any TRS employee involved. Drug and alcohol testing will be at the discretion of the TRS SQM and will occur as soon as possible following the incident/accident.

13.0 INCIDENT RESPONSE AND FIRST AID

In the event of an accident or emergency, the appropriate response is critical to minimize impact of the event. Proper preparation by maintaining the emergency call list and first aid supplies are vital to providing the appropriate response.

13.1. Personnel Roles, Lines of Authority and Communication System

A list of project emergency contacts is contained in **Table 7**. The list of emergency contacts will be kept on-site with the acting SHSO and posted in a prominent location inside the TRS field office. All staff will carry a working cell phone for emergency situations.

Table 6. Site-Specific Emergency Contact Information

Situation/Title	Response Agency/Name	Telephone Number
Emergency	Fire/Police/Rescue	9-1-1
Police (Non-emergency)	Washington Police Department	(908) 689-2111
County Sherriff	Warren County Sherriff's Department	(877) 277-3788
Medical	St. Luke's Warren Hospital	(908) 859-6700
Poison Control	National Poison Control	(800) 222-1222
Chemical Release	National Response Center	(800) 635-7179
Ramboll US Corporation – Primary Contact	Nita Shinn	(904) 947-0789
TRS Managing Director	Tim Warner	(617) 489-0535
TRS Corporate SQM	Greg Knight	(360) 560-4838
TRS Senior Project Manager	Chris Thomas	(360) 560-4845
TRS Project Manager	Sean Fournier	(978) 502-6525
TRS SHSO	Jeff Riffe	(765) 562-2252

13.2. Hospital Directions

The directions to Community Hospital East are provided in the HASP summary at the beginning of this document, in **Figure 1**, and below.

Nearest Local Hospital:

St. Luke's Warren Hospital
185 Roseberry Street
Phillipsburg, New Jersey 08865
908-859-6700
Hours: Emergency care available 24 hours, seven days a week

Distance: 12.5 miles, Drive Time: Approximately 12 minutes

Directions from Site (See **Figure 1**):

1. Head south on Route 31 South toward Myrtle – 0.5 miles
2. Turn **RIGHT** onto NJ-57 W/E Washington Avenue
3. Continue on NJ-57 W/E to US-22 – 11.0 miles
4. Slight **RIGHT** onto US-22 W – 0.5 miles
5. Turn **RIGHT** onto Roseberry Street – 0.3 miles
6. Turn **RIGHT**, St. Luke's is on the right. – 377 feet

13.3. Emergency and First Aid Equipment

Maintaining the proper emergency equipment and first aid supplies on-site during construction and operations are essential in preserving employee, sub-contractor, and visitor health and safety.

A list of health and safety equipment to be kept on-site is provided below:

- One AED
- Two 10 lb (minimum) dry chemical A-B-C rated fire extinguishers (equipment compound and site office trailer)
- One 15 lb (minimum) CO_2 fire extinguishers
- Air horn
- 15-minute eyewash and/or portable eyewash bottles (minimum of six 32 oz. bottles)
- Potable water
- Safety glasses
- Eye goggles
- Face Shields
- Ear plugs
- Tyvek® suits
- Hard hats
- Gloves - Nitrile
- Gloves – Neoprene

- One Spill kit (minimum 25-gallon capacity)

At least one First aid kit stocked in accordance with ANSI Z308.1-2003:

- At least one absorbent compress, 32 sq. in. (no side smaller than 4 in)
- At least 16 adhesive bandages, 1 in. x 3 in.
- One roll of adhesive tape, 5 yd total
- Two or more pairs of medical exam gloves (latex or non-latex)
- At least four sterile pads, 3 in x 3 in
- One triangular bandage, 40 in x 40 in x 56 in
- Additional (but optional) items include:
- Four 2x2 inch bandage compresses
- Two 3x3 inch bandage compresses
- One 4x4 inch bandage compresses
- One eye patch
- One ounce of eye wash
- One chemical cold pack, 4x5 inch
- Two roller bandages, two inches wide
- One roller bandage, three inches wide
- CPR barrier device
- Red biohazard bags
- At least ten packets of antiseptic, 0.5g (0.14 fl oz.) applications
- At least six applications of burn treatments, 0.5 g (0.14 fl. oz.)

13.4. On-Site Emergency Response

Procedures for emergency response are presented in the site-specific ERP presented in **Appendix E**. As part of project orientation, the SHSO (or designee) will review the ERP with all project staff.

First aid kits and other emergency response equipment including an AED will be located on-site in the equipment compound or TRS field office area and maintained by the SHSO. If an injured individual requires attention beyond first aid, the individual will immediately be transported to the nearest emergency medical facility. A map illustrating the route to the nearest hospital (with emergency care services) is shown in **Figure 1** and will be posted in a prominent location on-site. Injuries, regardless of severity, will be reported immediately to the SHSO and TRS SQM. Documentation of the incident will be completed in writing and submitted to the TRS Corporate SQM within 24 hours or as otherwise indicated by the SQM

In the case that an evacuation is needed, a horn or similar audible warning signal (car horn) will be sounded with three long blasts and repeated as necessary. Upon hearing this signal, on-site personnel will evacuate to the project primary muster point at the entrance to the Albea site from New Jersey Highway 31.

13.5. Communication System

Specific instructions for emergency response communication are provided in the site-specific ERP. In the case of any stop work action, near-miss event, incident, on-site personnel will contact the SHSO or TRS PM directly or by mobile telephone. The SHSO or PM will then follow the site-specific emergency response procedures (if needed) and associated notifications per the ERP.

Internal communication will be used for the following:

- Alert project team members to emergencies
- Pass along safety information
- Communicate changes in the work to be accomplished
- Maintain on-site control

Pre-arranged hand signals will be used for communication to personnel operating equipment, wearing PPE, respirators, etc. These hand signals will be interpreted as follows:

- Thumbs up - all clear
- Grabbing wrist of personnel – evacuate
- Hands on throat - help and/or choking

Equipment operators (forklift, skid-steer, backhoe, excavator, crane, and other heavy equipment) and their respective spotters will establish hand signals for the operation of and movement of equipment about the work areas. Equipment operators and spotters will agree on these hand signals prior to the operation of the equipment.

Off-site sources may need to be contacted to get assistance or to inform officials regarding hazardous conditions that may affect public or environmental safety (See **Table 6** for Emergency Contacts).

14.0 INCIDENT REPORTING, FOLLOW-UP, AND INVESTIGATION

On-site personnel and visitors will report all injuries, illnesses, equipment or property damage, spills/release to the environment, and near miss events, no matter how minor, to the SHSO, PM, or SQM as soon as possible when it is safe to do so (near-miss events or incidents can be reposted anonymously without reprisal). To prevent recurrence, every incident and near-miss event must be investigated as soon as possible to find the primary and contributing causes. A near miss event is an unplanned event, which does not result in personal injury, environmental release, or equipment/property damage but, in similar circumstances, likely could. If the conditions permitting the near miss event or “close call” are not eliminated, they will continue to contribute to the potential for future employee injury, equipment/property damage, or environmental release.

The following actions and reporting must be completed following an incident occurring at the project location:

- Immediately secure the situation to prevent further damage, injury, and/or future incidents
- The SHSO will report the incident verbally to the TRS PM and TRS SQM as soon as it is safe to do so

- Within 24 hours of the incident, the TRS PM will notify the client PM of any injuries, illnesses, spills, or property damage that occurred on-site.
- Within 48 hours of the incident, the TRS PM will confirm that the TRS incident reporting and investigation form has been completed. As most accidents involve unsafe conditions and/or unsafe acts, it is the responsibility of the investigators to uncover the root causes of the incident and develop action items to minimize the possibility of re-occurrence.
- Accidents that are recordable per OSHA requirements will be placed on the OSHA 300 logs of the appropriate company within six (6) working days by the TRS SQM.
- Government agencies will be notified as required. For example, if there have been any fatalities, hospitalizations, loss of an eye, or amputations and the TRS SQM will notify OHSA within the required time period.
- The corporate SQM will ensure that any new incident that occurred at a TRS project site will be reviewed by employees during division meetings and OSHA refresher courses.

15.0 RECORDKEEPING

TRS and its subcontractors must comply with OSHA recordkeeping requirements and standard TRS recordkeeping. The following records and documentation will be maintained on-site by TRS for the duration of the project:

- On-site training documentation (i.e., HASP, Restricted Zone, Right-to-Know)
- Heavy equipment inspections
- Daily tailgate meetings
- Daily construction reports
- Daily operations log
- Air monitoring logs and PID calibration records
- Site chemical inventory and associated SDS binder (reviewed and updated periodically and as needed)
- Posting of right-to-know required information, known on-site hazards, emergency response contacts, directions/map to hospital, and other pertinent site-specific information

The corporate SQM from each company involved in the project will maintain the following documentation for a minimum of three years:

- Documentation of safety and health training for each worker, including the worker's name or other identifier, training dates, type(s) of training, and training providers are recorded.
- Log and Summary of Occupational Injuries and Illness on OSHA Form 300 for annual posting. Relevant cases include:
    - An occupational death
    - An occupational illness
    - An occupational injury that involves the following:
        - Medical treatment other than first aid

- Overnight hospitalization for other than observation
- Hospitalization of three or more persons involved in an incident
- Loss of eye
- Amputation/loss of body part
- Loss of consciousness
- Restriction of work or motion
- Temporary assignment to another job
- Days away from work other than the day of injury

The Corporate SQM maintains the following documentation for a minimum of one (1) year:

- Site-specific inspections completed by the SQM or his designee.
- Incident investigations. Documentation includes a description of the incident, the investigation, corrective actions, and completion dates for corrective actions.
- SBOs
- Meeting minutes from Corporate Health and safety meetings

APPENDICES

APPENDIX A

HEALTH AND SAFETY PLAN REVIEW LOG

Document Title: _____

Site Safety and Health Officer: _____

By signing the page below, you certify that you have read and understood the information presented in this Health and Safety Plan and will abide by the criteria and specifications presented herein:

Name (Printed)	Date	Signature

HEALTH AND SAFETY PLAN REVIEW LOG

Document Title: _____

Site Safety and Health Officer: _____

By signing the page below, you certify that you have read and understood the information presented in this Health and Safety Plan and will abide by the criteria and specifications presented herein:

Name (Printed)	Date	Signature

HEALTH AND SAFETY PLAN REVIEW LOG

Document Title: _____

Site Safety and Health Officer: _____

By signing the page below, you certify that you have read and understood the information presented in this Health and Safety Plan and will abide by the criteria and specifications presented herein:

Name (Printed)	Date	Signature

Site TCH Restricted Zone Training Acknowledgement

TRS Site ID: _____
Site Address: _____

I have been trained by TRS Group, Inc. (TRS) in the following site-specific training at the thermal conduction heating (TCH) project site listed above. I have received training in the following TCH restricted zone-specific topics:

1. Proper lock-out and tag-out requirements to enter the TCH restricted zone.
2. Proper PPE requirements
3. Site-Specific training regarding potential hazards with TCH equipment. Training included (but not limited to) hot surfaces, pinch points, slip, trip, and falls, confined spaces.
4. Site-specific and task-specific training regarding site sampling requirements. Training included the potential hazards of sampling.
5. Training on location and function of Emergency-Stop (E-Stop). E-stop will deactivate TCH heaters but not vapor recovery or vapor/water treatment equipment. **In the event of an emergency (fire, electrical shock), press the red emergency stop button by the TCH control panel.**
6. On-site training for Emergency Response and the possible scenarios.
7. Completed project-specific Reading Assignments as outlined by the TRS Project Manager (PM)

My responsibilities are:

1. I will telephone the TRS operator in advance, if practical, to inform of the impending shutdown. The relevant telephone numbers are:

   TRS PM: _____ cell: _____
   TRS Assistant PM: _____ cell: _____

2. I will conduct a safety brief with all untrained personnel who will assist me in this work task. Affected personnel will be notified.
3. I will depress the primary circuit breaker, lock it in the open position using the proper breaker lock-out device, hang a lock-out notification tag on the lock-out device, and take personal possession of the key .
4. When work is complete, I will personally inspect the heater field to verify that all monitoring wells are sealed, and that all personnel have exited the heater field before reversing lock out procedure.
5. I will remove the lock-out notification tag from the circuit breaker lock-out device and unlock the device. Close the circuit breaker.
6. I will contact a TRS operator to re-start the TCH system.

TCH Restricted Zone Training Acknowledgement

TRS Site ID: _____
Site Address: _____

Date	Trainee Signature	TRS Trainer
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

TRS Accelerating Value

TRS Group, Inc. PID Calibration Log

Date	Time	Technician	PID #	Fresh Air Calibration (Y/N)	Fresh Air Result	Span Calibration (Y/N)	Span Result	Calibration Gas	Calibration Gas Lot #	Notes

TRS Accelerating Value

TRS Group, Inc.
Air Monitoring / PID Logsheet

Project: _____ **Instrument:** _____

Date: _____ **Calibration:** _____

Technician: _____

Date	Time	Breathing Zone (ppm)	Location/ID	PID (ppm)	Technician	Comments

HOT WORK PERMIT

All temporary operations involving open flames or producing heat and/or sparks require a Hot Work Permit. This includes, but is not limited to, Brazing, Cutting, Grinding, Soldering, Thawing, and Welding.

INSTRUCTIONS FOR FIRE SAFETY SUPERVISOR

1. **Verify precautions listed at right (or do not proceed with the work).**
2. **Complete page 1 and retain for job files.**
3. **Post page 2 in vicinity of hot work.**

DATE | JOB NO.

LOCATION/BUILDING & FLOOR (Be Specific)

DESCRIPTION OF WORK BEING PERFORMED

NAME OF PERSON DOING HOT WORK

The above location has been examined, the precautions checked on the Hot Work Checklist have been taken to prevent fire, and permission is authorized for this work.

SIGNED: _____
(Permit Authorizing Individual)

SIGNED: _____
(Person doing Hot Work)

SIGNED: _____
(Fire Watch)

TIME
STARTED: Date: _____ Time: _____ AM/PM

Date: _____ Time: _____ AM/PM

FIRE WATCH SIGNOFF

Work area and all adjacent areas to which sparks and heat might have spread were inspected during the fire watch period and were found fire safe.

Signed: _____

FINAL CHECKUP (minimum 30 minutes after Hot Work)

Work area was monitored for _____ hour(s) following Hot Work and found fire safe.

Signed: _____

FILL OUT EMERGENCY INFORMATION ON BACK OF Page 2.

HOT WORK CHECKLIST

OK		N/A
☐	Sprinklers and hose streams in service/operable.	☐
☐	Hot Work Equipment in good condition (e.g., power source, welding leads, torches, etc.)	☐
☐	Multi-purpose fire extinguisher and/or water pump can.	☐
	REQUIREMENTS WITHIN 35 FEET OF WORK	
☐	Dust, Lint, Debris, Flammable Liquids and oily deposits removed; floors swept clean.	☐
☐	Explosive atmosphere in area eliminated.	☐
☐	Combustible floors (e.g., wood, tile, carpeting) wet down, covered with damp sand or fire blankets.	☐
☐	Remove flammable and combustible material where possible. Otherwise protect with fire blankets, guards, or metal shields.	☐
☐	All wall and floor openings covered.	☐
☐	Walkways protected beneath hot work.	☐
	WORK ON WALLS OR CEILINGS	
☐	Combustibles moved away from other side of wall.	☐
	WORK IN CONFINED SPACES	
☐	Confined space cleaned of all combustibles (example: grease, oil, flammable vapors).	☐
☐	Containers purged of flammable liquids/vapors.	☐
☐	Follow confined space guidelines.	☐
	FIRE WATCH/HOT WORK AREA MONITORING	
☐	Fire watch will be provided during and for 30 minutes after work, including any coffee or lunch breaks.	☐
☐	Fire watch is supplied with an extinguisher, and/or water pump can, also making use of other extinguishers located throughout work area.	☐
☐	Fire watch is trained in use of this equipment and familiar with location of sounding alarm.	☐
☐	Fire watch may be required for opposite side of walls, above, and below floors and ceilings.	☐

OTHER PRECAUTIONS TAKEN

☐

WARNING!

HOT WORK IN PROGRESS
WATCH FOR FIRE!

IN CASE OF AN EMERGENCY:

CALL: _____

AT: 9 1 1

_____

WARNING!

Near miss Report

Brief description of work activity at time of incident	
Project Site	
Date of Incident	
Property Damage?	
Near Miss?	
Injury?	
Illness?	
Spill?	
Project Manager	
Personnel Involved	
Witnesses	
Complete Description	
Was First Aid Required?	
Did Employee Stop Work?	
Did the Incident Require a doctor's care?	
Steps taken to secure the scene/eliminate immediate danger/hazards	
Incident Reporting	
Sr. PM: Reported To	
Sr. PM: Reported By	
Sr. PM: Date Time Reported	
TRS HSO: Reported To	
TRS HSO: Reported By	
TRS HSO: Date Time Reported	
VP Operations: Reported To	
VP Operations: Reported By	
VP Operations: Date Time Reported	
Client: Reported To	
Client: Reported By	
Client: Date and Time Reported	
Any Other Applicable Regulatory Agencies: Reported To	
Any Other Applicable Regulatory Agencies: Reported By	

Near miss Report

Any Other Applicable Regulatory Agencies: Date Time Reported	
Incident Reporting Other Information	
Incident Investigation	
Participants of Investigation	
Incident Investigation Date and Time	
Were safe procedures followed?	
Was appropriate equipment (in good condition) used?	
Was appropriate PPE used?	
Were personnel properly trained?	
Was the incident in any way caused by a non-TRS employee?	
Describe answers and/or additional contributing factors in detail:	
What is/are the primary cause(s) of the incident?	
PREVENTIVE ACTION PLAN/RECOMMENDATIONS	
Action #1	
Action #1 - Responsibilities	
Action #1 - Responsible Person	
Action #1 - Timeline	
Action #1 - Completed	
Action #2	
Action #2: Responsibilities	
Action #2 - Responsible Person	
Action #2 - Timeline	
Action #2 - Completed	
Action #3	
Action #3 - Responsibilities	
Action #3 - Responsible Person	
Action #3 - Timeline	
Action #3 - Completed	
Action #4	
Action #4 - Responsibilities	

Near miss Report

Action #4 - Responsible Person	
Action #4 - Timeline	
Action #4 - Completed	
Additional Actions	
Additional Actions - Other Information	
Sign Off	
Employee Name	
Employee Signature Date	
Site Health & Safety Officer Name	
Site Health & Safety Officer Signature Date	
Project Manager Name	
Project Manager Signature Date	
Corporate Health and Safety Office Name	
Corporate Health and Safety Office Signature Date	

HEAVY EQUIPMENT SAFETY INSPECTION

Equipment Name: _____ **Week Ending:** _____
Equipment ID: _____ **Inspector:** _____

Inspected Item	Mon	Tue	Wed	Thur	Fri	Comments
Falling Object Protective (FOP) Structure						
Roll-Over Protection (ROP) Structure						
Seat Belts						
Operator Seat Bar(s)						
Side Shields, Screens or Cab						
Lift Arm Device						
Grab Handles						
Back-Up Alarm						
Lights						
Guards						
Horn						
Safety Signs (e.g., pinch points, swing area)						
Fire Extinguisher						
General Condition						
Oil (full and no leaks)						
Controls Function Properly						
Damaged Parts						
Hydraulic System (full and no leaks)						
Parking Brake						
Lift Arm and Bucket						
Tires / Tracks						
Steering						
Capacity Adequate for Task						
Other:_____						

TRS Group, Inc.

Safe Behavior Observation (SBO) Form

Project Number:	Client:	Date:
Staff Observed:	Observed by:	Time:
Task/Activity Observed:		

- ❖ Identify and reinforce safe work practices/behaviors
- ❖ Identify and improve on at-risk practices/acts
- ❖ Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
- ❖ Identify Root Causes for unsafe behaviors - use BBS tools to develop corrective actions
- ❖ Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
- ❖ Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	Safe	At-Risk	Un-Safe	Observations/Comments
Current & accurate Pre-Task Planning/Briefing (JHA, tailgate safety briefing, etc., as needed)				**Observations of Safe Work Practices:**
Properly trained/qualified/experienced				
Tools/equipment available and adequate				
Proper use of tools (hand & power)				**Observations of At-Risk Activities/Unsafe Conditions:**
Barricades/work zone control				
Housekeeping				
Communication				
Work Approach/Habits				
Attitude				
Focus/attentiveness				**Observer's Corrective Actions/Comments:**
Pace				
Uncomfortable/unsafe position				
Inconvenient/unsafe location				
Position/Line of fire				
Apparel (hair, loose clothing, jewelry)				
Repetitive motion				**Staff observed Corrective Actions/Comments:**
Other…				

Review: Please add one or more of the following **8 root causes** to the at-risk or unsafe columns if observed: **1.Failure to follow established practices and procedures, 2. Lack of established practice/procedure, 3. Lack of training, 4. Performed the task this way before without incident or problem, 5. Rushing and/or perceived pressure to complete the task quickly, 6. Short-cutting to complete the task easier or faster, 7. Lack of or failure to use proper equipment/tools, improper use or misuse of tools/equipment, and 8. Other (explain)**

TRS Group, Inc. Work Safer Everyday!

Daily Safety Tailgate Meeting Form

Site/Location: _____ Project #: _____

Project PM: _____ Project SHSO: _____

Meeting Held By: _____ Date: _____ Time: _____

Weather/Site Conditions: _____

Meeting Attendees: (Use reverse side to list additional attendees)

Name	Company	Name	Company

Working Alone ? YES ☐ If "YES", Approval Provided By: _____

NO ☐ Describe Monitoring Plan: _____

Daily Activities:

Site Walk ☐ Mobilization / Demob ☐ Drilling/Electrode Installation ☐ Construction ☐

System Start-Up/Shake-down ☐ System Operations / O&M ☐ Equipment Repair ☐ Other ☐

Describe Tasks: _____

Certified CPR/First Aid/AED Person:

Name: _____ Certification Date: _____

Tools & Equipment Required

Hand Tools ☐ (List) _____

Power Tools ☐ (List) _____

Heavy Equipment ☐ (List) _____

Ladders ☐ (List) _____

Fall Protection ☐ (List) _____

Traffic Control ☐ (List) _____

Activity Hazards

Electrical ☐	Slip / Trip / Fall ☐	Hot Work ☐	Respiratory ☐
Chemical ☐	Falls / Work at Height ☐	Lifting (manual) ☐	Eye / Face ☐
Thermal ☐	Overhead ☐	Lifting (crane) ☐	Dermal / Hands ☐
Pressurized lines ☐	Trench / Excavation ☐	Heavy Equipment ☐	Heat / Cold Stress ☐
Confined Space ☐	Noise ☐	Biological (plants/insects/etc) ☐	Other ☐

List Other: _____

PPE/Actions Required (for all hazards) _____

PPE Level: _____

Permits Required (for all hazards) _____

Lessons Learned (from previous day/week, near misses, self assessments, etc.):

Other / Miscellaneous: _____

Meeting Organizer Signature _____ Date: _____

TRS Group
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TRS "Day-1" Readiness Health & Safety Checklist

(To be Completed and All Items In Place Prior to Start of Field Work)

Date: _____

Site: _____

SHSO:_____ **HSO (Sign):** _____

Item	Qty	On Site? (Y or N)	Inspected (date)	Comments, Equipment Needed	Initials
Emergency Response:					
First Aid Kit					
Bloodborne Pathogen Kit					
Emergency Eye Wash					
Fire Extinguisher A-B-C					
Fire Extinguisher CO-2				not required until PCU is energized	
Emergency Numbers Posted					
Directions to Hospital Posted					
PPE:					
Hard Hats				Each staff should bring their own	
Safety Vests				Each staff should bring their own	
Safety Glasses (Sun)				Each staff should bring their own	
Safety Glasses (Clear)				Each staff should bring their own	
Nitrile Gloves (or equivalent)					
Repirators (each person)				All staff (including drillers) should have their own resp.	
Appropriate Resp. Cartridges				SHSO should stock w/ correct cartridges for COCs on site	
Dust Masks					
Administrative:					
Copy of HASP (final & signed)					
SDS Binder (for materials on site)					
SOP Binder					
AHAs (print out as needed)					
Air Monitoring Logs					
Tailgate Meeting Forms					
Other Equipment/Materials:					
PID (air monitoring)				may coordinate w/ Driller or Consultant	
Dust Meter (as needed)					

APPENDIX B

Standard Operating Procedure (SOP) Compendium

SOP	Title	Revision Number	Revision Date
1.1	Lockout Tagout	5	10/12/2017
1.2	Electrical Application	4	09/27/2017
1.3	Voltage Surveys	6	08/23/2017
1.4	High Voltage Inspection	3	03/28/2016
2.1	Waste Management	0	06/15/2017
3.1	Hot Groundwater Sampling	7	12/04/2017
3.2	Hot Soil Sampling	4	12/06/2017
3.3	Vapor Sampling Post condenser	3	06/15/2016
3.4	Vapor Sampling Pre-condenser	0	02/14/2017
3.5	Brazing	1	12/08/2011
3.6	SERT (Confidential)	1	04/03/2014
3.7	Lug and Heat Shrink	0	02/22/2016
3.8	ERH Electrode Installation	0	07/06/2016
3.9	ERH Borehole Logging	0	07/06/2016
3.12	Security System Integration (Confidential)	1	01/02/2018
3.12	Vapor Recovery Flow Measurement	0	07/28/2017

APPENDIX C

RESPIRATOR TRAINING AND FIT TEST PROCEDURES

Training

The respirator training included the following topics:

a. Nature, extent and effects of the respiratory hazards to which individuals may be exposed.
b. Explanation of why the particular type of respirator has been selected for the specific respiratory hazard.
c. Explanation of the operation, capabilities and limitations of the selected respirator.
d. Instruction in inspecting, donning, checking of fit and wearing the respirator.
e. Explanation of proper maintenance, cleaning and storage of respirators.
f. How to recognize and cope with emergency situations including situations in which the respirator malfunctions.
g. How to recognize medical signs and symptoms that may limit or prevent the effective use of a respirator.

Personnel shall watch the North® Respiratory Protection Training Video in order to gain a full understanding of general precautions when wearing a respirator. An understanding of respiratory hazards, signs and symptoms, and cartridge selection shall be covered in the site-specific Health and Safety Plan. Any questions regarding the specified training shall be directed to the TRS Corporate Health and Safety Officer (HSO).

Personnel must be reminded that a respirator must be properly cleaned, cared for, and stored in order to maintain its effectiveness; DO NOT LEAVE IT in the trunk of a car or bottom of a toolbox where it is susceptible to damage or excessive heat as it will warp, melt, or tear. See the manufacturer's manual for proper care information.

Assessment of Comfort and Adequacy of Respirator

Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- Position of the mask on the nose
- Room for eye protection
- Room to talk
- Position of mask on face and cheeks

The following criteria shall be used to help determine the adequacy of the respirator fit:

- Chin properly placed
- Tendency of respirator to slip
- Fit across nose bridge
- Adequate strap tension, not overly tightened
- Respirator of proper size to span distance from nose to chin
- Self-observation in mirror to evaluate fit and respirator position

Fit Check

Before beginning the Fit Test, personnel must demonstrate a successful positive and negative pressure check on the respirator. Personnel shall be instructed that the positive and negative pressure check must be completed **EVERY** time the respirator is worn.

Positive Pressure Check: Close off the exhalation valve and then gently exhale into mask. Fit is acceptable if a slight positive pressure can be built up inside the mask without any evidence of outward leakage at the seal.

Negative Pressure Check: Close off the inlet opening of the cartridges by covering with the palm of the hands, inhale gently so that the mask collapses slightly, and hold breath for 5 seconds. Fit is acceptable if the mask remains in its slightly collapsed condition and no inward leakage of air is detected.

Qualitative / Quantitative Fit Test

There are two kind of fit tests – qualitative and quantitative. TRS standard protocol is to complete a Qualitative Fit Test using Irritant Smoke. **Qualitative Fit Test:** With the wearer in a controlled space, an aromatic substance such as irritant smoke or banana oil is introduced. If the wearer cannot sense the substance inside the mask after simulating various work procedures, the seal is verified.

RESPIRATOR TRAINING AND FIT TEST PROCEDURES

Fit Test Exercises (Banana Oil, Irritant Smoke, Saccharin Mist: The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

☐Normal Breathing (1 minute). In a normal standing position, without talking, the subject shall breathe normally.

☐Deep Breathing (1 minute). In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

☐Turn Head from side to side (1 minute). Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

☐ Move head up and down (1 minute). Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

☐ Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

☐Bend over (1 minute). The test subject shall bend at the waist as if he/she were to touch his/her toes or jog in place.

☐Normal breathing. Same as first exercise (1 minute).

☐**Complete the Respirator Training and Fit Test Record & submit to the TRS HSO.**

RESPIRATORY TRAINING AND FIT TEST RECORD

TRS Accelerating Value

Employee Name: _____ Date:

(Check Appropriate) ☐ Initial Training ☐ Re-Training ☐ Fit Testing

RESPIRATOR TYPE

☐ Negative Pressure APR Half Face ☐ Powered Air Purifying

☐ Negative Pressure APR Full Face ☐ Supplied Air ☐ SCBA

Respirator Mfgr: MSA Model No.: 808071 Size: Medium

TRAINING TOPICS

The respirator training included the following topics:

a. Nature, extent and effects of the respiratory hazards to which individuals may be exposed.
b. Explanation of why the particular type of respirator has been selected for the specific respiratory hazard.
c. Explanation of the operation, capabilities and limitations of the selected respirator.
d. Instruction in inspecting, donning, checking of fit and wearing the respirator.
e. Explanation of proper maintenance, cleaning and storage of respirators.
f. How to recognize and cope with emergency situations including situations in which the respirator malfunctions.
g. How to recognize medical signs and symptoms that may limit or prevent the effective use of a respirator.

FIT CHECK AND FIT TEST

☐ Satisfactory Positive Pressure Check ☐ Satisfactory Negative Pressure Check

☐ Qualitative Fit Test Protocol Completed with Irritant Smoke

☐ PASSED FIT TEST ☐ FAILED FIT TEST

CERTIFICATION

I hereby certify that the above employee
has been trained and fit tested to wear the designated respirator.

Instructor (Signature): _____ Date: _____

ACKNOWLEDGEMENT

Employee (Signature): _____ Date: _____

APPENDIX D

APPENDIX E

TRS Group, Inc.

Site-Specific Emergency Response Plan:

Operable Unit 3

Pohatcong Valley Groundwater Contamination Superfund Site

Warren County, New Jersey

October 2019

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TRS Group, Inc.
Accelerating Value

Safe. Fast. Certain.
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Longview, WA 98632
www.thermalrs.com

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Abbreviations and Acronyms

CVOC	chlorinated volatile organic compound
E-stop	emergency stop
EMT	emergency medical technician
ERP	Emergency Response Plan
FEMA	Federal Emergency Management Agency
HASP	Health and Safety Plan
PM	Project Manager
PPE	personal protective equipment
Ramboll	Ramboll US Corporation
SHSO	Site Health and Safety Officer
SPM	Senior Project Manager
SQM	Safety & Quality Manager
TCH	thermal conduction heating
TRS	TRS Group, Inc.
WEA	Wireless Emergency Alerts

1.0 PURPOSE

TRS Group, Inc. (TRS) has prepared this Emergency Response Plan (ERP) as part of the site-specific Health and Safety Plan (HASP), dated October 2019, for Ramboll US Corporation (Ramboll) for work at the property located at 191 Route 31 North, Warren County, New Jersey (the Site). The purpose of this ERP is to establish an organizational structure and procedures for response to major emergencies. It assigns the roles and responsibilities for the implementation of plans during an emergency should they occur at the Site. As this ERP is part of the site-specific HASP, all Site personnel will review this ERP, understand their role(s) and responsibilities, and understand the procedures herein. All Site personnel will acknowledgement of their review of this ERP by signing the HASP acknowledgement form in **Appendix A** of the site-specific HASP.

2.0 PROJECT & SITE DESCRIPTION

TRS has entered into a contract with Ramboll for the remediation of trichloroethene (TCE) in groundwater at the Site. TRS will employ thermal conduction heating (TCH) technology to remediate TCE and TCE breakdown compounds in groundwater in the designated TCH treatment area and volume. See **FIGURE 1** for an aerial photograph of the Site and surrounding area.

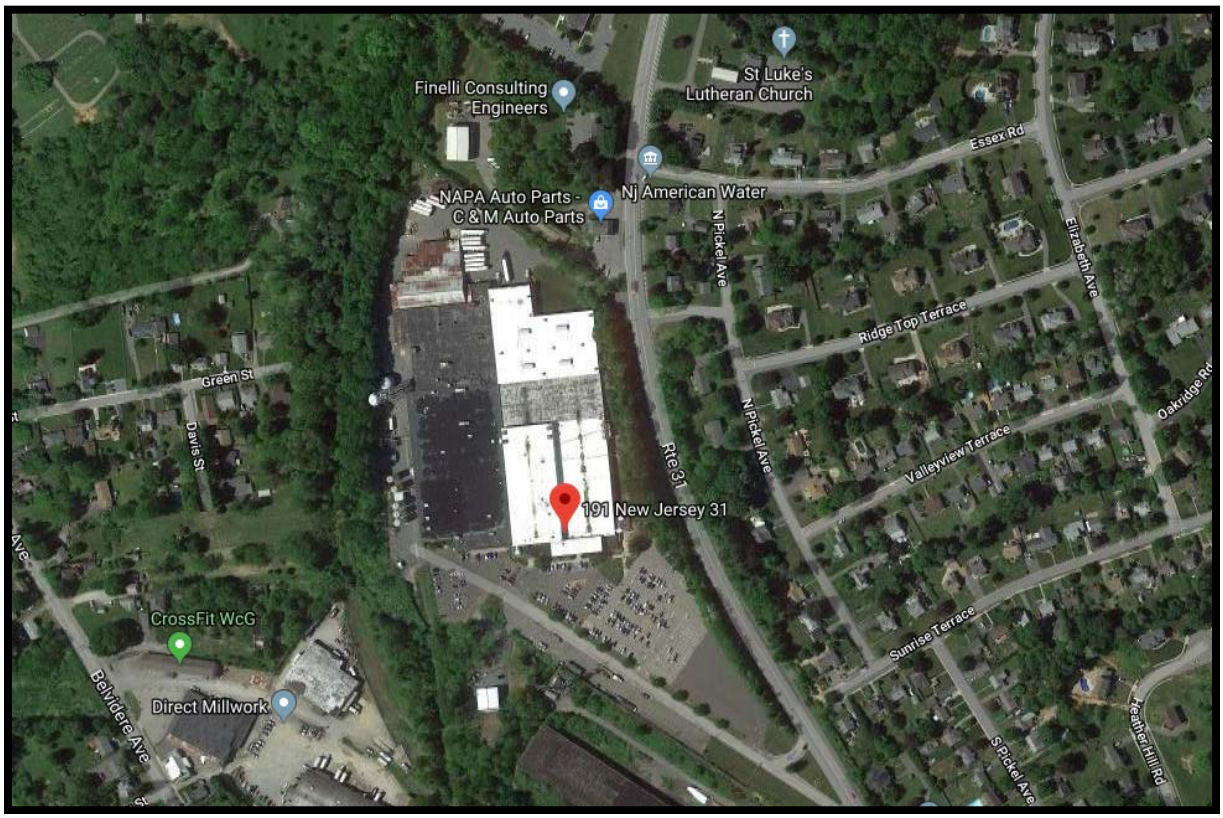

Figure 1. TCH Site

3.0 ROLES AND RESPONSIBILITIES

The TRS project team will generally consist of senior Project Manager (SPM), a Project Manager (PM), a site Health and Safety Officer (SHSO), support/technical staff, and TRS management support staff including the TRS Safety and Quality Manager (SQM). The following provides a description of the roles and responsibilities of TRS staff during emergency situations that may occur at the Site:

- **TRS SPM** – the SPM will serve as a point of contact to relay information to TRS executive and other management staff; will direct response actions as necessary through the PM, SHSO, and other TRS staff on-site; and will provide information regarding emergency response to the TRS client, property owner(s), and other applicable non-TRS Site contacts.
- **TRS PM** – when on-site, the TRS PM will serve as the emergency response Scene Commander; will coordinate with the TRS SHSO regarding emergency response actions and contacting appropriate authorities; will communicate Site emergency response information to the TRS SPM, will carry out emergency response actions in accordance with this ERP; and coordinate with the TRS SHSO and SQM regarding post-response review, investigation, and reporting.
- **TRS SHSO** – when on-site, the SHSO will serve as the emergency response Scene Commander in the absence of the TRS PM; will assume all the responsibilities of the TRS PM listed above; communicate with the TRS PM regarding status of emergency response actions; and coordinate with the TRS PM and SQM regarding post-response review, investigation, and reporting.
- **TRS SQM** – will prepare the ERP in accordance with local, state, and federal requirements; will consult TRS project staff regarding Site-specific emergency response actions required by the TRS client, property owner(s), and other applicable project groups or agencies; will assist TRS on-site staff with emergency response actions as needed; assist with communication of emergency response actions internally and externally as needed, and direct post-incident reviews and investigations and associated follow-up and reporting.

3.1. Emergency Response Chain of Command

The following provides the TRS staff succession for chain-of-command and emergency response Scene Commander during emergency response situations:

1. TRS PM – if present on-site, the TRS PM will assume the role of emergency response Scene Commander.
2. TRS SHSO – if the TRS PM is not on-site at the time that an emergency response takes place, he/she will assume the role of Scene Commander.
3. TRS Support Staff – if the TRS PM and SHSO are not on-site at the time of emergency response, the senior TRS employee (most tenured) on-site will assume the role of Scene Commander and fulfill all the responsibilities of the TRS PM as listed above.
4. In the case that no TRS staff are on-site at the time of emergency response, at the time of notification, the TRS PM will coordinate with on-site personnel to ensure Site safety with regards to TRS operations and equipment; as needed, the TRS PM will remotely shut-down TRS equipment as needed to ensure Site safety; and communicate emergency response status to appropriate TRS staff, client contacts, property owner(s), and other Site-related agencies or personnel.

4.0 SITE-SPECIFIC EMERGENCY RESPONSE PROCEDURES

The following provides a summary of specific response procedures to be followed in the case of a Site emergency. Note that there may be additional response procedures based on Site conditions or other factors that may be present at the time of the emergency and it is extremely important for the Scene Commander to communicate with and follow the instructions of local authorities and other officials or agencies that may also be involved with the emergency response. Site emergencies may include, but not be limited to, the following:

- Fire
- Unplanned release to the environment
- Incident involving personal injury and/or damage to equipment or property
- Vandalism, theft, and/or unauthorized Site entry
- Severe weather-related emergencies (i.e., severe rain storm, blizzard, electrical storm, tornado)
- Natural disaster (i.e., earthquake, flood)
- Unplanned loss of power
- Acts of violence (i.e., personal attacks/mugging, car-jacking, active shooter situations, hostage situations)

4.1. Site Muster Points

In the event of an emergency situation at the Site, a warning horn (air horn, car horn, or equivalent) will be sounded by the Scene Commander using three blasts of the horn. Upon hearing the emergency warning horn, all Site personnel will stop work and immediately retreat to the primary muster point at the Site. The primary muster point for the Site is outside of the property boundaries. Personnel will muster at the entrance to the Albea site from New Jersey Highway 31. Upon arrival at the muster point, Site staff will report in to the Scene Commander. It is the responsibility of the Scene Commander to account for all staff on-site and, to the best of their ability, ensure that staff safely retreat to the muster point. In the case that any Site staff is not accounted for during the emergency, the Scene Commander must notify emergency response personnel of any staff that may still be on-site and their last known location.

4.2. Fire Emergencies

In the event of a fire at the Site, the Scene Commander on-site will immediately sound the emergency warning and call 9-1-1 to notify the local emergency response system of the fire and provide specific information as requested by the 9-1-1 dispatcher (i.e., Site location, number of people on-site, location and nature of fire). The Scene Commander will complete the following (in order as numbered):

1. Sound Site emergency warning (air horn, car horn) using three blasts.
2. Call 9-1-1 as noted above.
3. Depress the TCH Emergency Stop (E-Stop) button if safe to do so.
4. Account for personnel on-site and move them to a safe location and/or the established Site muster point and assist any personnel in danger (only if it is safe to do so).

5. Only if it safe to do so and if the fire is small and contained, the Scene Commander can coordinate fire-fighting efforts using appropriate fire extinguishers on-site. All fire-fighting activities should follow the “Three A’s”:
    a. Activate alarms/9-1-1;
    b. Assist personnel in danger (if safe to do so); and
    c. Attempt to fight the fire (only if safe to do so).
6. Call and notify the appropriate TRS and other project related staff as defined in the “ERP Call Tree” in **Figure 2**.
7. Carry out the instructions of any emergency response personnel that may be on-site (Fire Department, Police, Emergency Medical).

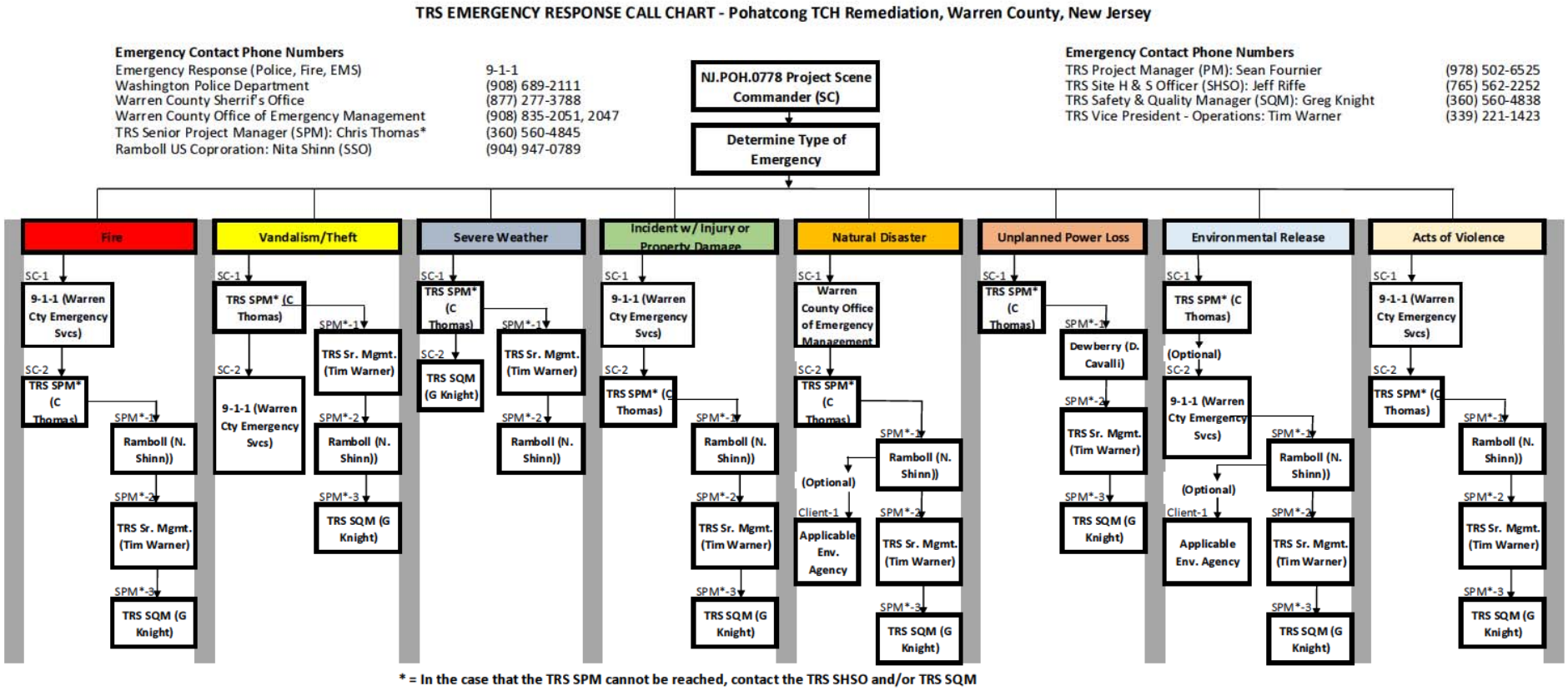

Figure 2. TRS Emergency Response Call Tree

4.3. Unplanned Environmental Release

In the event of an unplanned release of potentially hazardous materials to the environment, the Scene Commander will follow the procedures below (in order as numbered):

1. Identify the source of the release and determine if it safe to attempt to stop and contain the release. If it is not safe to deal with the release, proceed to **Step 9** of this section.
2. Confirm that all on-site staff are accounted for and address any personal injury situation as needed (see **Section 4.3**)
3. If it is safe to respond to the release, coordinate a team for response, develop a response plan, don appropriate personal protective equipment (PPE), and carry out the response plan. Note: this plan should be only to stop the source of the release and prevent further release of materials to the environment.
4. Once the release is contained, contact the appropriate TRS and other project-related staff to notify them of the release and Site status. Follow contact instructions provided in the ERP Call Tree (**Figure 2**).
5. Conduct an assessment of the release to include:
    a. Identify the material and quantity or volume released to the environment.
    b. Determine environmental receptor of the release such as soil, groundwater, surface water, air, local storm sewer or other subsurface conduits, or any combination of receptors.
    c. Determine what additional efforts are needed to contain and mitigate the release.
    d. Collect any other pertinent information associate with the release such as personal injury, equipment damage or failure, property damage, or public exposure potential.
6. Contact appropriate TRS and other project related staff with a status update based on the Site assessment noted above.
7. Coordinate with TRS SPM and other appropriate project staff (client, environmental consultant) to determine if the release exceeds the applicable reportable quantity. If so, coordinate notifying the appropriate authorities and/or agencies.
8. Coordinate with the TRS SPM and appropriate project staff and local agencies (as required) to develop plans for further release response and/or Site assessment.
9. In the case that the Scene Commander determines it is not safe to respond to the release, contact 9-1-1. Follow the instructions of the 9-1-1 dispatcher and any emergency response personnel that arrive on-site. After contacting the emergency response system, contact the appropriate TRS and other project staff regarding the release.

4.4. Personal Injury, Medical Emergency, Equipment Damage, and Property Damage Events

Upon notification of any personal injury or medical emergency situation, the Scene Commander will carry out the following procedure (in order as numbered):

1. Assess the injured person and determine if emergency medical response is needed. If emergency medical response is needed, call 9-1-1 immediately and follow the instructions of the 9-1-1 dispatcher. If emergency medical response is not needed proceed to **Step 5** of this section.

2. Provide and/or coordinate first aid if it is safe and those providing care are trained and qualified to do so. Collect information on the victim's status and vital signs and provide to emergency medical technicians (EMTs).
3. Notify the appropriate TRS and other project related staff of the incident per the ERP Call Tree (**Figure 2**).
4. Upon the arrival of EMTs, provide victim information as requested and follow instructions provided by EMTs.
5. If the injury is minor and emergency medical response is not needed, provide and/or coordinate first aid if it is safe and those providing care are trained and qualified to do so.
6. Notify the appropriate TRS and other project related staff of the incident per the ERP Call Tree (**Figure 2**).
7. Monitor the victim's condition, provide further treatment if needed, and assess to determine if professional medical attention is needed.
8. Update appropriate TRS and project related staff as needed.

In the case an incident occurs where there is damage to any property or Site equipment, the Scene Commander should conduct the following (in order as numbered):

1. Asses the incident to determine if the scene is safe. Terminate power to TRS equipment as needed to ensure scene safety.
2. Notify the appropriate TRS and other project related staff of the incident per the ERP Call Tree (**Figure 2**).
3. Coordinate with the TRS SPM to develop a plan to further assess equipment/property damage.
4. Power should only be restored to TRS equipment following approval from the SPM and/or appropriate TRS equipment management staff (i.e., Tom Powell, Eric Maki, Tony Strati)

4.5. Vandalism, Theft, and Unauthorized Site Entry

It is not uncommon at TRS sites for vandalism to occur due to the nature of the equipment and materials stored at sites. Vandalism and theft are usually accompanied with entry to sites by unauthorized persons. In the case of notification of unauthorized entry to the Site, the Scene Commander should conduct the following (in order as numbered):

1. Confirm, via remote access that the power to the electrodes has been shut down. If not, remotely shut down power to the electrodes.
2. Notify TRS SPM (and PM as needed) of unauthorized access and develop plan to ensure Site safety. Implement that plan accordingly.
3. Review TRS remote camera and/or motion sensor video to identify if unauthorized persons or police are on-site. If it cannot be confirmed that the Site is clear, notify the local police of the unauthorized entry and request that the Site be inspected by the police.
4. Once the Site is confirmed clear, consult with the SPM and coordinate re-energizing TRS equipment.
5. Notify the appropriate TRS and other project related staff of the incident per the ERP Call Tree (**Figure 2**).

In the case that it is determined that property vandalism and/or related damage to TRS equipment has occurred, the Scene Commander should conduct the following (in order as numbered):

1. Notify TRS SPM (and PM as needed) of unauthorized access and develop plan to ensure Site safety if needed.
2. Contact the local police department regarding the vandalism/property damage. Follow the instructions of police dispatch and other local authorities.
3. Notify the appropriate TRS and other project related staff of the incident per the ERP Call Tree (**Figure 2**).
4. Develop a plan for continued operations with the SPM. If it is necessary to re-energize the electrodes or other TRS equipment, prior approval from the SPM is required.

4.6. Severe Weather

The Site is located in an area of the country that can experience severe weather events. These severe weather events could include, but not be limited to, tornados, severe rain/electrical storms, and blizzards. On a daily basis, the TRS Site Supervisor or SHSO will review weather forecasts for the possibility of severe weather. It is recommended to utilize appropriate smart phone applications that provide real-time notification of severe weather events. If there is a potential for severe weather, the SHSO or Site Supervisor will work with TRS project management to develop and implement a plan to ensure the safety of Site personnel and to minimize potential damage to TCH equipment. That plan should include, but not be limited to, the following:

- Identification of Scene Commander to implement the severe weather plan, Site staffing, and associated task assignments for Site staff;
- Schedule for planned TCH equipment shut-down;
- Schedule for evacuation of Site personnel;
- Site clean-up and preparation of equipment (i.e., securing equipment doors, securing loose equipment and materials, tie-down of equipment as needed, covering of materials);
- Communication system for “all clear” and return to the Site;
- Communication to TRS management (SPM and SQM at a minimum) regarding severe weather conditions, plan to ensure safety of Site personnel, Site activities, and associated schedule; and
- Communication to client and/or property owner regarding severe weather conditions, plan to ensure safety of Site personnel, Site activities, and associated schedule.

It is recommended that the SHSO and PM activate the Wireless Emergency Alerts (WEA) system options on their mobile devices. This can be enabled in the mobile device’s settings or by dialing “##2627##” (without the quotation marks). This is a national system that can provide local weather and AMBER alerts. The WEA system will provide emergency warnings via phone and SMS text for several types of local emergencies including severe weather events and tornado watch conditions. If your mobile device is not wireless emergency alert-enabled, you can use multiple weather mobile device applications that can provide this service (typically for no charge). Weather Channel, Weather Underground, and Weather Bug are popular and free applications.

4.7. Natural Disasters

The Site is located in an area of the country where natural disasters might occur. Potential natural disaster could include, but not be limited to, severe thunderstorms and lightning, tornadoes, wild fires, or flood events. In the case of a tornado at or near to the Site, all on-site personnel should follow the tornado safety procedures developed by the Homeland Department of Security and Federal Emergency Management Agency (FEMA):

If you are in a building:

- Locate the strongest area of the building (interior room on the lowest level) or get to the basement. Avoid corners of the room.
- Do not run outside.
- Stay away from windows, doors, and outside walls.
- Use your arms to protect your head and neck. Use blankets and/or furniture to provide additional shielding.

If you are outside:

- Do not get under an overpass or bridge, you are safer in a low, flat location.
- Cover your body with a coat or blanket.
- Watch out for flying debris.
- Do NOT try to outrun a tornado in your vehicle.

Immediately following a tornado, the Scene Commander should conduct the following (in order as numbered):

1. Sound the Site emergency warning signal (three blasts from air horn/car horn).
2. Account for all on-site personnel and move all personnel to a safe location, the safe location may be the Site muster point or other location as deemed appropriate by the Scene Commander.
3. Terminate power to the electrodes by depressing the nearest E-Stop (if safe to do so) or remotely as needed.
4. Assess all Site personnel to determine if there are any injuries or other medical emergencies, in the case of any medical emergency follow the procedures presented in **Section 4.4** of this ERP.
5. Contact the Sparta Emergency Information Line (information in the ERP Call Tree – **Figure 2**) as needed to obtain information on proper emergency response actions or other procedures required or recommended by the agency.
6. Notify the appropriate TRS and other project related staff of the emergency situation per the ERP Call Tree (**Figure 2**).
7. Develop a plan to assess any damage to equipment or property and to return the Site to operation if possible. Plans for assessment and returning Site to operation should be communicated to the client, property owner, and other appropriate project contacts.

In the case of a pending flood event, the PM and/or SHSO should consult with the SPM to develop a plan to include, but not be limited to, the following:

- Identification of Scene Commander to implement the severe weather plan, Site staffing, and associated task assignments for Site staff.

- Schedule for planned TCH equipment shut-down,
- Schedule for evacuation of Site personnel.
- Site clean-up and preparation of equipment (i.e., securing equipment doors, securing loose equipment and materials, tie-down of equipment as needed, covering of materials).
- Communication system for “all clear” and return to the Site.
- Communication to TRS management (SPM and SQM at a minimum) regarding severe weather conditions, plan to ensure safety of Site personnel, Site activities, and associated schedule.
- Communication to client and/or property owner regarding severe weather conditions, plan to ensure safety of Site personnel, Site activities, and associated schedule.

4.8. Unplanned or Unexpected Power Loss

Unexpected loss of power may occur at any TRS site. Loss of power could be caused by severe weather, natural disaster events, failure of local power grid equipment, or other unexpected events. The Scene Commander should adhere to the following procedure (in order as numbered) in the case of unexpected loss of primary power at the Site:

1. Sound warning signal (three blasts from car horn/air horn).
2. Account for on-site staff at muster point(s) and assess staff for any personal injury or conditions requiring medical attention.
3. If safe to do so, turn all TRS equipment to the “OFF” position to prevent uncontrolled/unattended restart of the equipment.
4. Contact SPM and other applicable project management personnel and advise of the current status of the Site and develop a plan for restart of TCH equipment.
5. Contact client, property owner, and/or other applicable project contacts and advise of Site condition and plan for restart.
6. Contact the local power agency for information regarding the nature of the loss of power and any information regarding the restoration of power. Communicate any information from the local power agency to TRS project management. The local power agency for the Site is:

   Jersey Central Power & Light Co.
   Customer Service: 1-800-662-3115
   Emergency Service: 1-888-544-4877

4.9. Acts of Violence

Unfortunately, it is not uncommon in public buildings, private business, and other locations for acts of violence to occur. These acts of violence can include personal attacks, car-jacking, armed robbery, hostage situations, and even mass shooting events. All Site personnel are encouraged to place their personal safety and the safety of others on-site as the top priorities in any act of violence situation. There is no circumstance or situation where anyone’s personal safety is of less importance that any equipment, materials, or anything materials or property associated with the Site. In the case of any act of violence, all staff should contact 9-1-1 for emergency services as soon as it is safe to do so and follow all instructions from police and/or other emergency response personnel.

In the case of personal attacks, muggings, armed robbery, car-jackings, and other similar violent acts, the Scene Commander is advised conduct the following (in order as numbered):

1. Ensure the safety of the person(s) that was attacked, provide first aid as needed, and contact 9-1-1, follow the instructions of the emergency response dispatcher.
2. Ensure the safety of all other on-site personal; situations differ on if it will be safer to gather at a muster point or shelter in place until an all clear is sounded.
3. Notify the appropriate TRS and other project related staff of the incident.
4. Work with local authorities, emergency responders, and other pertinent Site personnel to provide all information needed to aid in any investigations.
5. Develop a plan with the TRS SPM, PM, and other pertinent personnel (local authorities, property owner, client) to return to normal work at the Site.

In the event that there is a hostage situation, mass shooting, or similar situation, the Scene Commander should attempt the following (in order as numbered):

1. Ensure the safety of Site personnel and if it is safe to do so, sound the warning signal (three blasts from car horn/air horn).
2. If safe to do so, the Scene Commander should use an E-Stop or remotely shut off power to the electrodes at the Site.
3. Staff should be instructed to report to the muster point if it is safe to do so or shelter in place in a safe location.
4. The Scene Commander and other Site staff (if not gathered with the Scene Commander at a muster point) should dial 9-1-1 and follow the instructions of the emergency response dispatcher and other emergency response personnel.
5. Specific recommendations for actions during an active shooter, hostage, or other similar situation are presented in the TRS 2016 training presentation titled “Responding to Emergencies at TRS Sites” (link below).

TRS Server/Training-Health & Safety Portal/H&S Documents/TRS HAZWOPER Refreshers/2016/TRS Site Emergency Response

It is highly recommended that the SHSO, or their designee, review the TRS Site Emergency Response presentation with all staff during Site health and safety orientations and during the course of the project (tailgate meeting topic). Also at the link provided above, information from the United States Department of Homeland Security on acts of violence and emergency response can be found and may be useful to help provide additional training to Site personnel.

5.0 POST-INCIDENT FOLLOW-UP AND REVIEW

The TRS SQM will decide the nature and extent of all Site incident follow-up(s). At a minimum, the Scene Commander will prepare an incident report through the TRS server within 24 hours following the incident.

The TRS SQM, depending on the nature of the Site emergency may elect to conduct additional investigation efforts. Where additional investigation is deemed appropriate, the TRS SQM may conduct the following:

- Develop investigation and review teams and select such personnel that may include other personnel other than TRS staff that were involved in the event;
- Conduct an on-site investigation;
- Schedule review sessions with TRS management and project management;
- Complete additional reports as needed for the client, property owner, and/or other persons or agencies at their request;
- Provide recommendations for further actions to be taken as needed; and
- Report findings to TRS management and communicate within TRS regarding the incident, lessons learned, and any further action items associated with the event.

APPENDIX F

APPENDIX G

Table 10: Personal Protective Equipment and Supplies

Equipment	Req	Rec	NA	Equipment	Req	Rec	NA
Safety Glasses with Side Shields	☒	☐	☐	Insect Repellent	☐	☐	☒
Vented (Splash proof) Goggles	☐	☐	☒	Other: High-Visibility Vest/Long-Sleeve Shirt	☒	☐	☐
Face Shield, required when potential for exposure to steam from subsurface	☒	☐	☐	Other: Hair bonnet and beard net	☒	☐	☐

Key:
Req = Required;
Rec = Recommended;
NA = Not Applicable

8. AIR MONITORING/SAMPLING PROCEDURES

Air samples may be collected during the project to identify and quantify airborne contaminants in order to delineate areas where PPE may be needed; determine the level of PPE necessary; document on-site employees' exposures; assess the potential health effects of exposure; determine the need to implement engineering controls or evacuate the work zone or Site; and determine the need for specific medical monitoring. Some commonly used devices include the following:

Combustible Gas Indicator (CGI) – An example of a CGI is a O2 / LEL meter. A CGI measures the concentration of a combustible gas or vapor. The limitations of a CGI include the following:

- Its accuracy is, in part, dependent upon on the difference between the calibration and sampling temperatures.
- Oxygen-deficient atmospheres affect accuracy.
- The filament can be damaged by silicones, halides, and tetraethyl lead.
- Its sensitivity is a function of the difference in the chemical and physical properties between the calibration gas and the unknown.

Flame Ionization Detector (FID) – An example of a FID is an Organic Vapor Analyzer (OVA). Depending on mode, a FID may detect many organic gases and vapors. The limitations of a FID include the following:

- It will not detect inorganic gases and vapors.
- It has reduced reliability in high humidity conditions.
- It should not be used when temperatures are below 40ºF (4.4ºC).

Ultraviolet (UV) Photo Ionization Detector (PID) – An example of a PID is a HNu. A PID detects a number of organic and some inorganic gases and vapors. Based on the PID device, volatile organic compounds are measured in parts-per-million (ppm) or parts-per-billion (ppb). The limitations of a PID include the following:

- It does not detect methane.

- It does not detect a compound if the probe used has a lower energy than the compound's ionization potential.
- It does not readily ionize fully chlorinated materials.
- High and low humidity affect its operation.
- Its response is sensitive to dust or moisture on the lamp.
- Responses will fluctuate when gases are mixed.

Infrared Spectrophotometer (IR) – An example of an IR is a Miran. This instrument measures concentrations of many gases and vapors in the air but is designed to quantify one- or two- component mixtures. The limitations of an IR include:

- It is not approved for use in hazardous conditions.
- It must make repeated passes to achieve reliable results.
- It is somewhat bulky/heavy.

Direct-Read Colorimetric Tubes – An example of a colorimetric tube is a Draeger Tubes. In a colorimetric tube, the compound reacts with the indicator chemical in the tube, producing a stain whose length is proportional to the compound's concentration. Limitations of colorimetric tubes include:

- The results are affected by temperature, pressure, and humidity.
- Many similar compounds interfere with results.

Personal Air Monitoring – An example of personal air monitoring is quantitative air sampling for nuisance dust, metals, organic compounds, and/or inorganic compounds. When using a personal air monitor, samples are collected using personal air sampling pumps and the appropriate sampling media. Personnel samples are collected in the employees' breathing zones over the duration of the work shift. The specific methods used for the collection of personal air samples will require the involvement of a Certified Industrial Hygienist (CIH) if this type of sampling is conducted.

8.1 Using Monitoring Devices

Conducting an applicable task may necessitate using one or more monitoring devices as listed in Table 11, particularly if gases, vapors, explosion hazards, and/or oxygen deficient atmosphere are present or are expected. If a monitoring device will be utilized, the corresponding device letter has been placed in the column labeled "Monitoring Instrument Required" in Table 12. In addition, the following information will be recorded in the field log book when using a monitoring device:

Instrument name and serial number,

Date of calibration,

Frequency/duration of monitoring,

The monitoring results, and

The actions taken based on the results, even if no actions are required to be taken.

Table 11: Monitoring Devices Available

A	PID (10.6 eV)	H	Summa Canister
B	PID (11.7 eV)	I	Heat Stress Monitor
C	FID	J	Air Sampling: personal air monitoring (passive badges)
D	OVA	K	Air Sampling:

Table 11: Monitoring Devices Available			
E	CGI/LEL	L	Radiation Detector
F	Colorimetric Indicator Tubes	M	Gas Multimeter
G	Dust Monitoring	N	Other Device: Noise dosimeter

Table 12: Required Monitoring

Required Monitoring If monitoring is necessary to identify that a risk is at or above tolerable limits and/or is used in controlling a risk on site, document the task and the maximum allowable exposure or trigger, and the monitoring instrument required to be used.	Constituent	Task(s)	Trigger (action level)	Monitoring instrument required
	Oxygen	6, 9	19.5% to 23.5%	M
	H2S	6, 9	5 ppm	M
	C2S	N/A		
	CH4	N/A		
	Carbon monoxide	6, 9	50 ppm	M
	Combustible gas	6, 9	10% LEL	M
	VOCs: Total	4,6,9, 10, 11	TLV-TWA action level: 5 ppm [sustained for 5-minutes] TLV-STEL action level 12.5 ppm [for 15-minute]	A, F, J
	SVOCs:	N/A		
	Metals	N/A		
	Dusts	N/A		
	Other: Noise	6,8,9,10 ,11	85 dB (continuous noise) 140 dB (impulse noise)	N

8.2 Action Level Guidance

In general, this HASP addresses site-specific chemicals with their respective monitoring action levels noted in Tables 12 and 14. However, there are chemicals commonly encountered in the workplace that may not be a chemical targeted for sampling but nonetheless will have adverse health effects. These chemicals are listed in Table 13.

Table 13. Action Levels for Commonly Encountered Compounds

Compound	Action Level
VOC (as Benzene)	0.5 ppm MAXIMUM
CH4	0.5% MAXIMUM or 5000 ppm
CO2	0.25% OR 2500 ppm MAXIMUM
CO	25 ppm MAXIMUM
H2S	5 ppm MAXIMUM
O2	19.5% MINIMUM – 23.5% MAXIMUM

8.2.1 Volatile Organic Compounds

Due to VOCs present from facility operations, additional monitoring will be conducted while conducted activities inside the Albea facility, as described below.

The action levels listed in Table 14 are based on 50% of TLV-TWA and TLV-STEL for TCE (see Table 5 for TCE's TLV-TWA and TLV-STEL). If a sustained (as indicated in Table 14) total VOC reading within the breathing zone as determined by a PID is above the action level listed, site personnel shall attempt to mitigate the situation through the use of engineering controls (e.g., increase air circulation) or administrative controls (e.g., stand upwind) as indicated in Table 14. If the readings are still above the action level, colorimetric indicator tube (e.g., Draeger tubes) samples specific for TCE and toluene will be collected from the breathing zone. If colorimetric indicator tubes indicate that concentrations of TCE or Toluene are above their respective action levels (i.e., 5ppm for TCE and 10 ppm for Toluene), personnel shall leave the area and contact the PM and HSC for further instructions. If colorimetric indicator tubes indicate that TCE or Toluene concentrations are below their respective action levels, then the PID action level will be revised. If TCE does not exceed its action level (5ppm), but Toluene exceeds its action level (10ppm) then an action level of 10 ppm will be used. If neither TCE or toluene exceed their action levels, then an action level of 100 ppm will be used (e.g., half of the lowest exposure limit for the other known compounds [isopropanol, ethyl acetate, and toluene] and that have been detected during past and recent air sampling events [isopropanol and ethyl acetate]). Colorimetric indicator tube sampling for TCE and/or Toluene will be conducted every 15 minutes while PID readings remain above 5ppm.

Personal air samples will be collected over the duration of 1 or 2 days (two 8-hour shifts each), if needed, of drilling to establish and evaluate employee full-shift TWA exposures to TCE. Sampling will be conducted in accordance with applicable National Institute of Occupational Safety and Health (NIOSH) and Occupational Safety and Health Administration (OSHA) methods.

Table 14: Volatile Organic Compounds

Instrument	**Calibration Gas Standard**	**Frequency / Duration of Air Monitoring**	**Action Level([1]) Above Background (Breathing Zone)[1]**	**Action**
Step 1: Monitor Worker Breathing Zone with PID				
PID - total VOCs	Calibrate at least once per day using 100 ppm isobutylene	A) 5-minute data-logged average (collect throughout duration of shift); and/or B) 15-minute data logged average (at least once every 2 hours)	IF: A) >5 ppm (TLV Action Level) B) >12.5 ppm (STEL Action Level)	Evaluate existing controls and introduce additional engineering and/or administrative controls.
Step 2: After Introduction of Engineering Controls, Again Monitor Working Breathing Zone with PID				

Instrument	**Calibration Gas Standard**	**Frequency / Duration of Air Monitoring**	**Action Level([1]) Above Background (Breathing Zone)[1]**	**Action**
PID - total VOCs	Calibrate at least once per day using 100 ppm isobutylene	C) 5-minute data-logged average (collect throughout duration of shift); and/or D) 15-minute data logged average (at least once every 2 hours)	IF: A) >5 ppm (TLV Action Level) or B) >12.5 ppm (STEL Action Level)	Collect colorimetric indicator tubes (e.g., Draeger tubes) samples for TCE and Toluene.
Step 3: Collect Colorimetric indicator tube sample for TCE, if required by Step 2.				
Colorimetric indicator tubes (e.g., Drager tubes) – TCE only	N/A	Collect as required by Step 2.	If result is >5 ppm (TLV Action Level) If result is significantly <5 ppm for TCE and <10 ppm for toluene (TLV Action Level)	Leave area, and contact PM and HSC for further guidance. **The PID action level will be revised to 100 ppm if TCE and Toluene are not present above their respective action levels (5 ppm and 10ppm, respectively)** (lowest TLV Action Level of isopropanol or ethyl acetate) Colorimetric indicator tube sampling for TCE will be conducted every 15 minutes while PID readings remain above 5ppm .
Step 4: If the action level is revised to 10 ppm, collect routine colorimetric indicator tube samples for TCE and Toluene.				
Colorimetric indicator tubes (e.g., Drager tubes) – TCE and Toluene	N/A	Collect routinely, at a minimum every two hours during intrusive drilling activities.	If result is above or approaching 5 ppm for TCE If result is above 10 ppm for Toluene	PID Action level will be returned to the action level for TCE (5 ppm). Leave area, and contact PM and HSC for further guidance.
Step 4: If the action level is revised to 100 ppm, collect routine colorimetric indicator tube samples for TCE and Toluene.				

Instrument	Calibration Gas Standard	Frequency/ Duration of Air Monitoring	Action Level([1]) Above Background (Breathing Zone)[1]	Action
Colorimetric indicator tubes (e.g., Drager tubes) – TCE and Toluene	N/A	Collect routinely, at a minimum every two hours during intrusive drilling activities.	If results are at or approaching 5 ppm for TCE or 10 ppm for Toluene	PID Action level will be returned to the appropriate action level for TCE (5 ppm) or Toluene (10 ppm). Action level will depend on which constituent is detected. If both are detected at concentrations at or nearing their respective TLVs, then use the more restrictive TLV of 5 ppm for TCE.
			If result is <5 ppm for TCE and <10 ppm for Toluene (TLV Action Level)	Continue using current action level.

8.2.2 Combustible Gas Indicator (CGI)/Oxygen Meter

Diesel -powered equipment (e.g., drill rig, forklift) will be used during drilling operations. Equipment will be ventilated to the outside. Additionally, a multi-gas meter will be used to monitor the breathing zone adjacent to and surrounding the drilling operations to verify proper ventilation is maintained. The multi-gas meter will run continuously over the shift to monitor for oxygen, carbon monoxide, and the lower explosive limit.

Table 15: Combustible Gas Indicator (CGI)/Oxygen Meter

Meter Response	Action/Respiratory Protection
CGI response <10% LEL	Continue normal operations with regular, periodic monitoring
CGI response > 10% LEL	Discontinue operations; evacuate personnel and prohibit entry; allow to vent until readings are <10%.
Oxygen level <19.5% or >23.5%	Retreat from work area; consult with PM and HSC about upgrading to Level B respiratory protection, adding mechanical ventilation, or possible changes in work practices.

8.2.3 Odors

If strong odors are encountered or if personnel develop headaches, dizziness or other potential exposure symptoms, the personnel shall move from the work area to a well-ventilated area and contact the PM and HSC for further instructions.

8.2.4 Dusts

The permissible exposure levels for total and respirable dusts are 15 and 5 mg/m3, respectively. In general, you will not be able to read the face of a wristwatch (with your arm extended) when the total dust concentration reaches 15 mg/m 3. Particles of dust in the respirable size range cannot be seen without the aid of a microscope but in aggregate, may be perceived as a haze. More importantly and

with few exceptions, when dust is noticeable in the air, more respirable particles will exist than larger particles.

Typically, controlling dusty investigative activities through the use of a water sprayer will control potential exposures. However, in the event that dusty conditions exist that are not related to investigative/remedial activities (e.g., dry, uncovered soils with high winds), personnel shall leave the area and contact the PM and HSC for further instructions.

Nonetheless, to determine the likelihood of exposure from dusts, a theoretical "Total Dust" concentration in mg/m3 can be calculated to estimate the total dust concentration in which the concentration of the contaminant in the soil could equal and/or exceed its' established exposure limit (EL). This equation is as follows:

Total Dust (mg/m3) = (10^6 mg/kg) (EL mg/m3) / (Conc. of contaminant in soil mg/kg) (SF)

Where:

EL = Exposure Limit of the contaminant of concern (e.g., its PEL or TLV in mg/m 3) and

SF = Safety Factor, a number between one and ten. Used to account for the degree of confidence in the characterization data (a ten would represent a poor degree of confidence, for example only one soil sample was collected / analyzed to characterize the site).

The **SF** is based upon the following assumptions: 1) the concentration of the contaminant in the airborne dust is the same as its' concentration in the sample matrix; 2) the soil data represents "worst-case" scenario; 3) the monitoring instrument accurately measures the ambient concentration of particulate matter in the air; and 4) a single contaminant of concern is present.

As an example, assume that lead (with an EL of 0.05 mg/m3) is the contaminant of concern and a soil concentration of 25,000 mg/kg has been identified. Depending on the SF used, the theoretical total dust concentration will range between 2 and 0.2 mg/m3. This means that when the in-situ particulate monitoring device is registering a concentration within the 2 to 0.2 mg/m 3 range, there is a high probability that this dust contains enough lead to equal and/or exceed the EL. Hence, the level of PPE used would be increased until engineering controls are determined to be effective as documented by personal monitoring.

9. CONFINED SPACE ENTRY

Ramboll's health and safety policy prohibits unauthorized entry into confined spaces. In the event that entry into a confined space is required, Ramboll employees (or its subcontractor's employees) will need additional training prior to entering the confined space. Without supplemental Confined Space training, entry into confined spaces is prohibited. In addition, entry authorization will only be given after Ramboll management has reviewed the nature of the confined space, the hazards present, and the measures needed to ensure safety. Under these circumstances, Ramboll will work with the host facility/client to determine training requirements, sampling requirements, written program requirements, and equipment needed to safely enter the confined space.

Though confined spaces will be present on the Site, no confined space entry will be required for Ramboll personnel on this project. If confined space entry is required, management approval will be required and this HASP will be modified accordingly to adhere to all applicable regulations.

RALLY POINTS

In the event of an evacuation (e.g., unsafe conditions are observed such as a trespasser present on-site) from the immediate work area, one rally point (i.e., safe location) has been identified for the Vikon Tile Property and for the Albéa Property. Albéa Facility rally points for Albéa employees are also shown in the Site Map (Attachment G).

Albéa Property The rally point is the GWETS Trailer. Once Site personnel have migrated to the specified rally point, the Site Supervisor will account for Site personnel and will report this information to the Project Manager.

Albéa Facility Evacuation: In the event of an evacuation of the Albéa facility, audible alarms, and strobe lights will commence. During a facility evacuation, Ramboll personnel should also migrate to their designated rally point(s) until an all clear is given by Albéa Security.

SITE-SPECIFIC EMERGENCY RESPONSE PLAN

Please note, a separate, site-specific Emergency Response Plan (ERP) has been prepared for the PVGCS Site. The site-specific ERP must be reviewed in consonance with this HASP.

APPENDIX H

CONTINGENCY PLAN

Prepared for:
Pechiney Plastic Packaging, Inc.
South Jordan, Utah

Submitted to:
United States Environmental Protection Agency Region II
New York, New York

Date:
December 2019

Project Number:
1690008019

CONTINGENCY PLAN

OPERABLE UNIT 3, POHATCONG VALLEY GROUNDWATER CONTAMINATION SUPERFUND SITE, WARREN COUNTY, NEW JERSEY

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RAMBOLL

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TABLES

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ACRONYMS AND ABBREVIATIONS

Albéa	Albéa Americas, Inc.
CPR	cardiopulmonary resuscitation
HASP	Health and Safety Plan
ISTR	*In-Situ* Thermal Remediation
OM&M	Operation, Maintenance, and Monitoring
OU	Operable Unit
PLC	Programmable Logic Controller
PPPI	Pechiney Plastic Packaging, Inc.
PVGCS	Pohatcong Valley Groundwater Contamination Superfund
Ramboll	Ramboll US Corporation
TCH	thermal conductive heating
TRS	TRS Group, Inc.
TTZ	Target Treatment Zone
USEPA	United States Environmental Protection Agency
VEW	vapor extraction well
VFD	variable frequency drive
VGAC	Vapor Granular Activated Carbon

1. INTRODUCTION

On behalf of Pechiney Plastic Packaging, Inc. (PPPI), Ramboll US Corporation (Ramboll) has prepared this Contingency Plan associated with the Operable Unit 3 (OU3) remedy implementation at the Albéa Americas, Inc. (Albéa) facility located at 191 Route 31 North in Washington, New Jersey ("Site"). The remedy includes treatment of soils below the facility building as described in the accompanying OU3 Design Report.

The site activities include installation of heaters and vapor extraction wells, construction of vapor conveyance and treatment systems, construction of a liquid condensate treatment system, and operation and monitoring of the thermal conductive heating (TCH) system.

Contingency plans will be implemented if an incident occurs which might threaten human health or the environment. This Contingency Plan provides the necessary information and procedures to coordinate the handling of emergencies in the unlikely event that any should arise during construction and/or operation of OU3 TCH remedy.

2. EMERGENCY COORDINATION

2.1 On-Site Emergency Coordinators

During construction and startup, Ramboll will have a Construction Manager and Site Safety Officer at the work area. The manager and/or Site Safety Officer will act as the emergency coordinator in the event of an emergency. Ramboll has given authority to the above-mentioned emergency coordinator to expend funds and recruit trained employees in the event an incident. The emergency coordinator will respond and assess if the problem can be controlled by the construction crew without evacuation. If not, the area will be evacuated and the Albéa emergency contact (Plant Manager) and the Fire Department (and the affected utility, if appropriate) will be called. The emergency coordinator will work closely with the Albéa Plant Manager to coordinate the emergency procedures. The emergency coordinator will note the time, date, and details of any incident that requires implementation of this Contingency Plan. As needed, Rio Tinto will file a report with the United States Environmental Protection Agency (USEPA) Project Manager. The Site Safety Officer will make sure that cleanup and restoration have progressed at least to the point of not jeopardizing the health and safety of the employees or the environment before permitting resumption of the operations affected by the emergency.

During operation, a qualified system operator from TRS Group, Inc. (TRS) will serve as the emergency coordinator as noted above. The operator will be on site 8 hours a day, 5 days per week, and on-call in case of an emergency.

2.2 Emergency Contacts

2.2.1 Ramboll Emergency Contacts

Ramboll's Project Manager will be notified of any emergency or damage as soon as possible after the situation is stable as follows:

- Bruce Kennington, Ramboll (will contact Rio Tinto)
  - Telephone: (cell) 312-953-9965
    (office) 312-288-3834

- Alternate: Scott Tarmann, Ramboll
  - Telephone: (cell) 262-853-9964
    (office) 262-901-0093

2.2.2 Other Contacts

- Albéa Contact (Plant Manager): Russell Gladd – (cell) 908-674-1479
- TRS Senior Project Manager: Chris Thomas - (cell) 360-560-4845
- TRS Site Supervisor: Kevin Riffe – (cell) 360-560-1891
- St. Luke's Hospital (Emergency: 908-859-6700) personnel are trained in physical trauma and chemical exposure treatment (Address: 185 Roseberry Street, Phillipsburg, New Jersey)
- Medical, Fire, Police Emergency: call 911
- Fire Department (non-emergency): 908-689-3836
- Police Department (non-emergency): 908-689-1630

See Emergency Contact List (Table 1) for electric, water, and natural gas emergency numbers.

3. EMERGENCY RESPONSES

3.1 Spill Response

All waste materials will be managed and handled in accordance with the project work plan requirements and applicable regulations. Solid materials will be contained in roll-off containers or drums. All process equipment involved in the pumping and treatment of recovered liquids will be housed within secondary containment. Any potentially hazardous liquids will be stored within drums or totes within secondary containment prior to onsite treatment or offsite disposal. Roll-off containers, drums and totes will be segregated from work areas to minimize damage to the container to prevent a spill. Given this, TRS does not anticipate the need for significant spill response during this project. However, TRS will be prepared for primary spill response actions in the unlikely event of a spill. The field team will be equipped with a spill response kit and will be prepared to create earthen berms, when necessary, to control the spread of any spilled materials. TRS will notify Ramboll and other appropriate emergency personnel in the event of a spill requiring a response.

3.2 Fire/Explosion Response

In the event of a fire or explosion, TRS will:

- Ensure that all equipment is shut off.
- Phone 911 for emergency assistance.
- Rally at designated location and take head count.
- Secure the area until emergency assistance arrives.
- Meet emergency crew and advise fire chief of location and nature of the situation.
- Follow the Notification Procedure specified in Sections 2.1 and 2.2.

3.3 Tornado/Earthquake Response

In the event of a tornado or earthquake, TRS will:

- Sound alarm.

- Phone for assistance.
- Take head count.
- Secure immediate first aid.
- Meet emergency crews and advise of situation.
- Secure area and assess replacement need and phone Ramboll to ensure client has been notified.
- Begin investigation when safe, if applicable.

3.4 Flood/Hurricane Response

In the event of a flood or hurricane, TRS will:

- Maintain contact with local news reports.
- Take precautions to protect personnel.
- Remove, shelter, or otherwise protect equipment.
- Secure all items that could be blown away.
- Fill all tanks/vessels/drums that cannot be secured to prevent floating.
- Phone office and others who must be notified.
- Secure area and leave, if possible.
- After public safety has been established, return and assess the situation.

3.5 Emergency Equipment

The following emergency equipment will be on site during construction and operation:

- industrial first-aid kit with instant cold packs;
- bloodborne pathogen protection kit with cardiopulmonary resuscitation (CPR) mouth shield;
- emergency eyewash;
- Fire extinguishers (20-pound, ABC) (one extinguisher for every 3,000 square feet or work site area)
- Spill Kit Spill Response.

4. CONTINGENCY PROCEDURES

The *in-situ* thermal remediation (ISTR) system has numerous contingency features and processes to address possible incidents including: vapor emissions, power failure, etc. Operating and monitoring procedures designed to maintain and confirm operation within designated parameters are described in the Operations, Maintenance and Monitoring (OM&M) Plan and summarized below. The triggers for contingency actions are described below for critical elements of the ISTR system. Spill and emergency response procedures are discussed in the Health and Safety Plan (HASP).

4.1 Loss of Grid Power

Upon a loss of grid power, the Programmable Logic Controller (PLC), which is on a battery backup, will send an Alert Notification to the System Operator(s). Operator Actions and Potential Impacts are provided below:

Actions	Potential Impacts
• Heaters and process treatment systems automatically shut down. • TRS System Operator(s) automatically notified. • TRS System Operator(s) report to Site within 30 minutes (if not already on site) or as soon as possible. • Emergency generator will start automatically. • TRS System Operator(s) restart process treatment system on dilution air. • Wellfield block valve is opened, and vapors are extracted and treated from subsurface.	• Vapor and liquid extraction and treatment systems typically restored within 1 to 2 hours. • Heaters remain off until grid power is restored.

4.2 Loss of Wellfield Vacuum

Localized positive pressure incursions are possible and, in fact, are expected to occur during the heating phase of the project. However, if the net pressure at the perimeter of the wellfield is excessive as indicated by increasing temperatures outside of the Target Treatment Zone (TTZ), it may be an indication that there is a leak in the vapor collection system or that the steam pressure has risen to the point where it is exceeding the vacuum being applied to the wellfield.

Operator Actions:

- Inspect manifold lines for leaks. Tighten any leaking fittings.
- Inspect process treatment system lines for leaks. Tighten any leaking fittings.
- Evaluate neighboring vapor extraction wells (VEWs) for possible leaks or flow obstructions.
- If no leaks are found or the problem persists, notify the Project Engineer and Project Manager.
- Increase operating vacuum to that area of the wellfield (valve back vacuum/flow from other areas to compensate if needed). Continue monitoring response in wellfield to ensure that this does not create pressure/vapor capture problems in other areas of the wellfield.
- If problem persists, notify Project Engineer to get permission to turn off power to neighboring heater wells until the VEWs can effectively capture the process vapors in the area and reduce the pressure to acceptable levels.

4.3 Manifold Piping Failure

In the unlikely event that a section of manifold pipe fails during operation, spare pieces may need to be fabricated on short turnaround. Replacement procedures will vary depending on which piece fails.

Operator Actions:

- Notify the Project Manager immediately.
- Isolate the failed segment to the extent possible using the manifold valves.
- If replacing one of the branch lines, detach the flexible hoses up to the point of the failure and reinstall them in the replaced section.
- Where manifold connections are available, install a temporary bypass around the failed section of pipe.

- To replace a failed section of manifold piping, precut and glue a replacement section to two couplings, cut out the failed portion and quickly replace it with the pre-cut replacement.

4.4 Main Blower Failure

The main blower is provided with an installed spare that can be energized immediately. Blower failure is often preventable through proper maintenance.

Operator Actions:

- Start standby blower, adjust valve positions, and place it into service.
- Check condition of wellfield.
- Turn off or reduce applied power to the heaters as needed to maintain proper vapor control.
- Notify Project Manager.
- Troubleshoot failed blower to determine whether problem is blower, variable frequency drive (VFD), motor, or belts.
- Coordinate with Project Engineer to arrange for blower repair/replacement.

4.5 Pump Failure

Troubleshoot and replace if necessary. Backup pumps or spare parts will be available for immediate replacement in the event of a treatment system pump failure.

4.6 Vapor Granular Activated Carbon (VGAC) Failure

Observing pressure drop and temperature, comparing inlet and outlet vapor concentration, and periodic interior inspection can prevent VGAC failure. It is essential to monitor the operating temperature entering and exiting the VGAC vessels. The PLC will monitor the carbon vessel discharge temperature and will alarm if the temperature exceeds the high limit. Running the carbon beds above 300°F creates a fire hazard. Temperatures within the carbon vessel will vary according to time of day, incoming vapor stream temperature, and flow rates. When the VGAC vessels are on line and if temperatures begin to approach the high temperature alarm setting, the vessel should be immediately isolated and taken off line by closing all valves.

4.7 Other

Other contingency plans include the following:

- In the case of PLC battery failure, there will be a backup battery on site.
- In the case of operator unavailability, there will be a second local operator that is trained in the system.
- In the case of impacted indoor air as identified by the regular indoor air monitoring, the flow of existing sub-slab extraction system will be increased.
- In the event there is a prolonged groundwater extraction treatment system shutdown, arrangements will be made for offsite disposal of the condensate water from the storage tank by vac-truck or for mobilization of a temporary secondary condensate water holding tank.
- In the event of a breach of the security perimeter by an untrained person, power to the heaters will be discontinued by the PLC to prevent potential injury.

TABLE 1: EMERGENCY RESPONSE TELEPHONE ROSTER

	Office	Cell
CLIENT CONTACT		
Luis Hidalgo, Rio Tinto Project Manager	801-569-6412	435-932-3955
Brad Gibson, Rio Tinto Site Manager	385-434-4819	801-557-8236
RAMBOLL PERSONNEL		
Principal In Charge: Mark Travers	312-288-3890	312-375-8080
Project Manager/Project Coordinator: Bruce Kennington	312-288-3834	312-953-9965
HSEQ MS Coordinator: Alyssa Larson	303-382-5463	847-732-8656
Site Safety Officer: Jeff Parsons		315-391-0638
Project Engineer: Scott Tarmann	262-901-0093	262-853-9964
Project Manager: Stan Popelar	312-288-3858	815-793-6442
Project Manager (PPW & MNA): Angela DeDolph	312 288-3816	224 659-9102
Designated Site Safety Officer: Adrian Ezeagu	609-243-9849	517-214-5732
Designated Site Safety Officer: Nita Shinn	813-397-4730	904-947-0789
Designated Site Supervisor: Michael Eddings	913-553-5929	785-250-3648
Designated Site Supervisor: Doug Burge	314-590-2963	314-378-8065
Designated Engineering Support: Cynthia Bonczkiewicz	312-288-3813	224-659-9105
Designated Engineering Support: Beth Richter	312-288-3856	314-630-7364
Global Director, Health and Safety: Jim Fox	315-956-6813	
GENERAL CONTRACTOR		
GWTT		
Project Manager: Pat Biskey	973-983-0901	973-224-4120
HSE Representative: Tiffany Brown		201-317-2063
Site Safety Officers: Mark Turner Teague Alessi	 NA NA	 973-487-6326 973-879-2460
Treatment System Operators: Mark Turner	NA	973-487-6326
TRS Group		
TRS Project Manager: Chris Thomas	847-376-3691	360-560-4845
Shift Superintendent and H&S Manager: Jeff Riffe	765-562-2252	765-562-2252
Shift Superintendent and H&S Manager: Kevin Riffe	360-560-1891	360-560-1891
TRS Health and Safety Officer: Greg Knight	303-722-7762	360-560-4838
ALBÉA FACILITY/SECURITY		
EHS Leader: Felix Miranda		908-619-2159
Engineering Manager and OU3 Albéa Contact: Russell Gladd	908-835-5231	908-674-1479

EMERGENCY RESPONSE AGENCIES		
Hospital: St. Luke's Warren Hospital	911	
Emergency Fire	911	
Emergency Police	911	
Warren County Health Department	908-475-7960	
Ambulance Service: Washington Emergency Squad	908-689-0909	
Washington Township Emergency Management: Frank Campbell		609-685-1545

OTHER EMERGENCY ASSISTANCE		
CHEMTREC	800-424-9300	
National Response Center (oil and chemical spills)	800-424-8802	
Poison Control Center	800-222-1222	
Federal Emergency Management Agency	202-646-2500	
State Agency: NJ Dept. of Environmental Protection Hotline	877-927-6337	

OFF-SITE AGENCIES – NON-EMERGENCY PHONE NUMBERS		
Police: Washington Township Police Department	908-689-1630	
Hospital: St. Luke's Warren Hospital	908-859-6700	
Medical Clinic: Medical Care Associates	908-574-5731	
Fire: Washington Fire Department	908-689-3836	
Ambulance Service: Washington Emergency Squad	908-689-0909	
Federal Agency: US Environmental Protection Agency, Region 2	212-637-4232	
State Agency: New Jersey Dept. of Environmental Protection	866-337-5669	
Washington Township Emergency Management: Frank Campbell	856-589-0523	
General	856-589-6650	

	Emergency	**Non-Emergency**
UTILITIES – EMERGENCY & NON-EMERGENCY PHONE NUMBERS		
Electric: New Jersey Power and Light	888-544-4877	800-662-3115
National Gas: Elizabethtown Gas	800-492-4009	800-242-5830
Vince Holmes, Elizabethtown Gas Representative	908-413-6856	908-413-6856
Water: New Jersey American Water	800-987-5325	800-652-6987
Sewer: Washington Borough Sewer Department	908-835-2000	908-689-0623
Internet/Telephone/Cable: Verizon - Tony Rogers, Local Manager		973-902-3625
Comcast		908-689-3355